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outlined in the Bulletin.

The Editor's notes are marked (E.).

FIRST PART. ORIGINAL ARTICLES

Sheep and Pig Breeding in the Argentine Republic at the Present Day

by
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of the National University of Buenos-Aires.*

The 1908 census showed there to be, in the Argentine Republic, 7 211 754 sheep and 1 403 591 pigs. In 1914 the figures were estimated at 8 148 519 sheep and 3 197 337 pigs. These figures show an increase in both kinds of animal, but, in order to form an exact idea, it is wise to await the definite results of the last census, especially in the case of sheep, the total number of which is very uncertain. At present it is only possible to state that, in the Province of Buenos Aires, the sheep continue to decrease rapidly, as is shown by Table I. It is to be hoped that this decrease is only due to an exodus to the lands in the south of the Argentine which are less expensive and, as yet, uncultivated.

I. — SHEEP BREEDING.

Table I shows, for the various provinces of the Argentine Republic, the number of sheep given in the censuses of 1888, 1895, and 1908. The estimated number of sheep for 1915 is given for the Province of Buenos Aires only.

TABLE I. — *Number of Sheep in the Argentine from 1888 to 1915.*

Province	Census			
	1888	1895	1908	1915
Buenos-Aires	51 337 750	58 630 451	54 604 972	18 528 641
Santa Fé	2 977 382	1 988 777	969 406	—
Santa Rosa	4 901 123	6 210 185	7 005 406	—
Corrientes	611 085	1 405 101	3 138 563	—
Misiones	2 335 030	2 594 662	1 992 110	—
Paraná	1 670 393	5 295 177	4 809 077	—
San Juan	287 940	1 009 777	4 724 844	—
Salta	—	47 306	2 123 628	—
Santa Cruz	—	369 264	2 387 566	—
Tierra del Fuego	282	7 165	1 342 551	—

In 20 years the province of Buenos Aires has lost about $\frac{2}{3}$ of its sheep, and those in the provinces of Santa Fé and Córdoba are also decreasing. If it were simply a question of change of breeding centres from agricultural districts to more uncultivated ones, no harm would be done, but there would appear to be losses greater than those foreseen and due to: 1) a series of unfavourable years; 2) a high mortality among lambs; 3) loss caused by staggers ("lombriez") and scab ("sarna"); 4) the heavy demands made by home consumption and exportation.

HISTORICAL DATA: Like the other domestic animals of the Argentine (1), the sheep are descended from the animals brought by the Spaniards from their native country at the time of the conquest. It is thus that, on the banks of the Plata, are found Churra and Merino sheep; left to themselves, they multiplied rapidly and produced the two local breeds called "pampa" and "criolla" (creole), which represent respectively the degenerated types of the two above-mentioned Spanish breeds.

The "pampa" sheep, found especially in the provinces of the Andes and of the north, were of good height, not very fat, active, with long limbs, white face, long, soft, glossy wool. The males had sometimes 3, or even 4, long, straight horns.

The "criolla" sheep were only used for meat production, and, for a long time, were not shorn. They were smaller than the former breed, with short, coarse wool of varying colour.

For many years only the skins and fat of these sheep were used, for even the lowest classes did not eat the meat, since they had a sufficiency of cattle.

The "graserías" (tallow factories) used millions of sheep, and even their dried bodies were used as fuel in the brick ovens.

When wool began to increase in value and the exportation of agricultural products became of great importance, the breeders began to see the defects of the local breeds of sheep, and began to improve them by crossing with Merinos, first of the Electoral and Negrete type, then of the Rambouillet type. A gradual substitution of one breed for the other took place, giving rise to animals of better conformation producing a much finer and more abundant wool. During this period of "merinomania" (as it was called at its zenith), very high prices were paid for the best breeding stock and, during the years 1836 and 1837, over 4 200 were imported from Germany alone.

But, no sooner did the frozen meat industry start, than the direction of sheep breeding was again changed. Many crossing experiments with the early maturing mutton breeds of the United Kingdom soon showed that, by crossing cross-bred Merinos with Lincolns, animals were obtained which were strong, easy to fatten, relatively early in maturing and producing a long, fine, abundant wool. Towards 1885, the gradual conversion of 40

(1) On this subject see the preceding articles by the same author: *Horse-breeding in the Argentine Republic at the present day*, in R. June 1917, p. 819. — *Cattle-breeding in the Argentine Republic at the present day*, in R. August 1917, p. 1073.

million Merino sheep into Lincoln sheep was started. Since then the Merinos still predominate in districts where the influence of the frozen meat industry is not yet felt (Corrientes, Pampa, the south), but the greater part of the national breeding is concerned with the Lincoln type.

IMPROVEMENT OF THE NATIVE BREEDS. — Tables II, III and IV, show the importance of crossing the native breeds and the present day trend of sheep breeding.

TABLE II. — *Creole, cross-bred and pure bred sheep in the Argentine from 1888 to 1908.*

Breeds	Creole sheep	Cross-bred sheep	Pure-bred sheep
1888	24 322 214 = 36.5 %	42 002 871 = 63.1 %	270 010 = 0.4 %
1895	17 938 061 = 24.1 %	56 106 187 = 75.4 %	335 314 = 0.5 %
1908	10 583 523 = 15.7 %	55 448 749 = 82.6 %	1 179 482 = 1.7 %

TABLE III. — *Proportion of pure breds and cross-breds in the various breeds of sheep in 1908.*

Breeds		Pure-bred	Cross-bred
Rambouillet . . .	male	25 449	178 441
	female	205 796	8 551 941
Negrete	male	1 910	4 768
	female	11 769	370 464
Lincoln	male	56 018	316 817
	female	367 936	17 566 445
Shropshire	male	3 905	11 024
	female	14 149	275 872

TABLE IV. — *Importation of breeding sheep from 1900 to 1914.*

Breed	Number	Breed	Number
Carakul	6	Leicester	315
Lincoln	27 510	Merino	291
Rambouillet	1 554	Southdown	145
Hampshire	1 936	Shearling	75
Wendishire	516	Various	1 249
Romney Marsh	1 783	<i>Total</i>	<i>35 383</i>

The figures in Table IV show that, at the present day, two groups of English sheep predominate — the Romney Marsh and the Downs.

The Romney Marsh, which are stronger and more resistant than the Lincolns, but always good breeders for both purposes, were bred in the extreme south of the Republic, where the climatic and food conditions are very difficult. They gave excellent results and are now being bred in other districts, where climatic or other conditions are unfavourable to the Lincoln breed.

As for the Downs, and more especially the Shropshires and Hampshires, they do very well in the "alfalfares" (lucerne fields), and in the good pasture lands, and it seems that, the more small estates increase in

number, and the more intensive agriculture becomes, the more attention will be given to these breeds.

An idea of the relative importance of the various improving breeds can be obtained from Table V, which gives details of the sheep entered in the register of the "Sociedad Rural Argentina" from the 1st. October, 1915 to the 1st. October, 1916.

TABLE V. — *Sheep entered in the register of the "Sociedad Rural Argentina" from the 1st. October, 1915 to the 1st. October, 1916.*

Breed	Definite register		Preparatory register	Total
	Males	Females	Females	
Lincoln	2 237	8 953	7 502	18 692
Argentine Merino	1 007	2 377	—	3 384
Shropshire	57	203	222	482
Hampshire	55	219	219	493
Oxfordshire	49	86	1 128	1 263
Romney Marsh	121	617	581	1 322
Border Leicester	9	126	—	135
Corriedale	1	—	50	51
Total	3 536	12 581	9 703	25 822

The quality of these breeding stock is usually very good, especially that of the Lincolns, Romney Marsh and Downs. A slight deterioration is seen among the Rambouillets, but they still offer a large choice of animals of superior type.

EXPORTATION OF MEAT AND WOOL. — Tables VI to XI give details of the exportation of live and frozen sheep and of wool at different periods.

TABLE VI. — *Exportation of live and frozen sheep from 1876 to 1915.*

Period	Live sheep (%)	Frozen sheep (%)
1876-1880	156 571	—
1881-1885	168 168	—
1886-1890	148 308	3 618 105
1891-1895	778 122	7 091 383
1896-1900	2 335 517	11 521 433
1901-1905	464 287	16 633 163
1906-1910	486 091	14 597 644
1911-1915	480 000	12 217 901

(1) Up to 1903 a large proportion of the live sheep exported went to England, but after the closing of this market most of them were sent to Belgium, Uruguay and Bolivia.

(2) Nearly all the frozen sheep are sent to the United Kingdom.

TABLE VII. — *Total number of sheep slaughtered for home consumption and exportation, from 1910 to 1914.*

1910	5 583 777	1913	3 307 528
1911	6 235 229	1914	4 519 352
1912	4 781 547		

TABLE VIII. — *Exportation of wool from 1829 to 1914. Quantities and average prices.*

Year	Tons	Average price in gold pesos (1) per 10 kg
1829	333.5	—
1850	7 681	—
1860	17 317	—
1870	65 704	—
1880	97 518	—
1885	128 393	2.80
1890	118 406	3.00
1895	201 353	1.54
1900	101 113	2.77
1905	191 007	3.37
1910	150 599	3.91
1914	117 270	4.00

(1) 1 gold peso = 32.11 1/2d.

(Ed.).

TABLE IX. — *Comparative values of various types of wool, from 1904 to 1906 (in paper pesos) (1).*

Wool	1904	1905	1913	1916
Fine Lincoln	9-9.3	9-10	12-18	10-17
Medium	9-9.5	8- 8.5	11-18	10-18
Coarse	9-9.7	7- 8	11-18	10-17
Fine Rambouillet	8-8.5	9-11	7-11	7-13

(1) 1 paper peso = 1s. 9d.

(Ed.).

TABLE X. — *Price of sheep for the frozen meat industry on the Buenos Aires market, from 1904 to 1916 (in paper pesos).*

Type	1904	1907	1909	1913	1915	1916
<i>us-bred Lincoln Sheep:</i>						
pecial	8-9	8.0-8.5	9.5-10.5	15-20	18-20	15-17
at	7-8	7.5-7.8	9.0- 9.5	—	16-18	11-13
<i>us-bred Rambouillet Sheep:</i>						
at	6-7	6.0-7.0	8.0- 8.5	13-14	16-17	11-12
<i>us-bred Lincoln Ewes:</i>						
pecial	—	7.5-8.5	7.0- 8.0	15-18	20-22	14-15
at	—	6.0-7.0	7.0- 8.5	12-14	15-17	12-13
<i>us-bred Rambouillet Ewes:</i>						
pecial	—	6.0-7.0	6.0- 6.5	13-14	15-17	12-13
at	—	5.0-5.5	5.0- 5.5	11-12	12-13	9-10

These figures need no commentary. The values attained by wool and meat are worthy of note and justify the high prices paid for good breeding animals. Table XI gives the prices realised at the last exhibition of the "Sociedad Rural Argentina".

TABLE XI. — *Prices of breeding sheep realised at the exhibition of the "Sociedad Rural Argentina" (in pesos).*

Breed	Average price		Maximum prices Males
	Males	Females	
Argentine Merino	332 pesos	50 pesos	2 500 pesos
Lincoln	547	216	4 000
Romney Marsh	294	252	670
Corriedale	250	—	330
Shropshire	300	120	500
Oxfordshire	282	100	500
Hampshire	305	—	1 000

II. — PIG BREEDING.

Of all domestic animals, pigs are those which, till recent years, least attracted the attention of the Argentine breeder. This was due to many causes: — 1) they were looked upon as animals which do well only under conditions of intensive breeding; 2) many great failures; 3) the mortality caused by certain diseases (tuberculosis, echinococcosis, distomatosis); 4) the small market demand. Recently, however, new factors have appeared which have greatly modified prevailing opinion and permit a splendid future to be foreseen for the pig industry.

BREEDING CONDITIONS. — In various districts of the Argentine, especially in the south of the provinces of Buenos Aires and Córdoba, energetic and intelligent breeders have successfully proved that certain breeds of pigs (especially Berkshire and Poland China) may thrive on pasture only, on condition that it is abundant and completed with a little maize, and that certain hygienic precautions are taken.

In the "alfalfares" (lucerne fields) district, breeding "a campo" (in the open) is very profitable. We have personally visited many breeding farms where thousands of pigs are bred every year with the best results. The pigs are kept in lucerne fields a few acres in size, surrounded by wire fences ("potreros alambrados y alfalfados"); these enclosures are similar to those used in the Argentine for other animals, but are smaller.

With the exception of the mother sows and their young, who are kept in simple and primitive pens (a roof, manger and sub-divisions of wood and iron) (1), all the animals live entirely in the open. In order to prevent their spoiling the pasture by digging and burrowing they are submitted

(1) An original type of pig-sty consists in a cage without a floor, made of laths of wood which is placed in the lucerne fields daily. The mother sow is shut up in it to browse the lucerne, whereas the young pigs can easily go in and out by passing through the laths. (A. W. S. S.)

This system is described in R. 1914, No. 1031.

(E4)

when quite young, to an easy operation called "destrompadura". This operation consists in removing the upper part of the end of the snout. The wound heals, but the place remains tender, and the animal loses the habit of burrowing.

Feeding with lucerne and a little maize suffices to keep the pig in excellent condition, and it is only a few months before it is sold that a larger quantity of concentrated food-stuff is given.

For the two above mentioned breeds (Berkshire and Poland China), two litters of an average of 4 to 6 pigs each, may be relied upon each year. Twelve, or even more, pigs may be kept on 1 hectare (2.47 acres) of lucerne. Berkshire is the favourite breed, but other dark breeds (Poland China and Large Black) are also much in demand and well represented.

The white breeds (especially Middle White) are found on the most intensive breeding farms, usually attached to, or more or less dependent on, large cheese-factories. These breeds cannot bear either the direct and continual sun or great cold, and at present are only in demand by farms which have the necessary conditions for breeding them.

DISEASES. — In open pasture, if the animals are vaccinated against swine plague and regularly dipped in dilute solutions of creolin, there is very rarely a high mortality.

On breeding farms which utilise the residues of cheese-making, if these residues are not sterilised before being fed to the pigs, numerous cases of tuberculosis frequently occur. These are spread by the "tambos" cows (1), which are very subject to this disease.

IMPROVEMENT OF THE CREOLE PIG. — The original or "criollo" pig of the Argentine is descended from breeds imported by the Spaniards. Degenerating completely it has become a wild animal, slow in developing; it is covered with thick, bristling hairs, variously marked, is bony, with long legs, narrow and badly developed body and long, straight head.

By crossing these animals with good English and American stock the breeders have obtained the present day breed.

Table XII gives data on the number of pure-bred and cross-bred animals of various breeds: Table XIII shows the number of breeding stock imported from 1900 to 1914.

TABLE XII. — *Animals entered in the Argentine Swine Book.*

Breed	Male	Female	Total
Berkshire	1 220	5 205	6 425
Middle White	1 388	1 869	3 257
Large Black	1 167	1 278	2 445
Poland China	109	130	239
Tamworth	85	142	227
Large White	43	67	110
Duroc Jersey	36	41	77
Lincolnshire	—	1	1
Total	7 048	8 830	15 878

(1) See the preceding article by the same author: *Cattle-Breeding in the Argentine Republic the Present Day*, in R. August 1917, p. 1073.

TABLE XIII. — *Number of breeding stock imported from 1900 to 1914.*

Year	Yorkshires	Berkshires	Various	Total
1900	—	—	2	2
1901	—	—	—	—
1902	9	—	—	9
1903	12	7	—	19
1904	61	431	—	492
1905	50	117	—	167
1906	35	211	67	313
1907	203	598	140	941
1908	35	327	180	542
1909	25	52	5	82
1910	10	10	—	20
1911	—	10	—	10
1912	—	9	27	36
1913	36	149	128	413
1914	—	43	131	174
Total	476	2 064	680	3 220

MEAT INDUSTRY. — This industry, whose modern development dates from about 1900, has undergone various fluctuations, principally due to the prices of pigs and maize. Table XIV shows the variations in the export of frozen pigs from 1885 to 1904.

TABLE XIV. — *Number of frozen pigs imported from 1885 to 1914.*

Year	Number of pigs	Period	Number of pigs
1885-1889	953	1900-1914	798
1890-1894	2 151	1905-1914	Almost none
1895-1899	1 640		

From 1904, certain frozen meat companies undertook only the production of salted and otherwise preserved pig's flesh, thus, for example, the "LAS PALMAS PRODUCE COMPANY, LIMITED" dealt with 12000 pigs in 1904 and 32 000 in 1909. The "Frigorifique Argentin" slaughtered 5 468 animals in 1907. These are certainly not large quantities, but, if it be borne in mind that the total number pigs of slaughtered in the frozen meat factories in 1909 was 25 731, as against a home consumption not exceeding 150 000 animals, it is seen that the figures quoted may be both a help and a stimulant. At the same time, the high prices paid for pork were very profitable for from 40 to 50 *centavos* and even 60 to 70 *centavos* were paid per kilo gramme of live weight. This led to a great boom in this industry for many years, followed by a great depression due to the fact that the frozen meat factories ceased to buy, causing prices to go down. In 1912-1913 there was a new rise, followed by another depression. At the present time the trade is improving.

The exportation of frozen pork was of little importance for several years and finally stopped altogether (see Table XIV). This trade is now becoming very important since the founding at La Plata of the ARMOUR refrigerating

ting establishment, which is capable of dealing with 2 000 pigs a day.
The ARGENTINE BACON CURING COMPANY, LTD., has also established at
Rosario, a factory for the products of pig's meat.

We feel certain that the right road has now been reached, and do not
doubt that, in a few years, the Argentine pork industry will make gigantic
 strides; this hope is based on the following facts:

- 1) In the future, countries which might compete with the Argentine
will always export less, or under less favourable conditions, either because
of the increase in home consumption or because of the distance.
- 2) Extensive pig breeding with pasture and maize, as practised in
the Argentine, makes production easy and cheap.
- 3) The constantly increasing area under maize will allow, for pig
fattening, large stocks of this concentrated food, the price of which will al-
ways be sufficiently low to make its use economical.
- 4) The growth of the dairy industry and the increase in the number
of small estates favour the intensive breeding of pigs.
- 5) The founding of frozen meat and other establishments dealing
solely with pig's flesh will regulate prices and give a sure and constant
outlet for production.
- 6) The demand of European markets will become greater, and to
them will *perhaps* be added those of the United States, which already
import frozen beef from the Argentine.

SECOND PART. ABSTRACTS

AGRICULTURAL INTELLIGENCE

GENERAL INFORMATION.

790 - **The Agricultural Development of North-West India.** — HOWARD, A. and HOWARD, G. L. C. in *The Agricultural Journal of India, Special Indian Science Congress Number*, 1917; pp. 67-76. Agricultural Research Institute Pusa, 1917.

The development of the agriculture of North-West India is largely a question of the conquest of an alluvial desert by means of irrigation. The deep soils of this region are practically inexhaustible.

The position of irrigation at the present time is this: Government has provided the country with a magnificent system of canals by which production has been increased and by which large areas of the country have been protected from famine. The farmers, however, do not know the irrigation practice and waste this valuable water, without considering that over-watering on an alluvial soil leads to low yields of poor quality, to accumulations of salts and to destruction of the porosity of the subsoil. The necessity of increasing the supply of organic matter in desert soils is often lost sight of and insufficient use is made of the nitrogen-collecting leguminous crops.

The object of this paper is to suggest a means by which the fertility of the soil in this region can be increased and by which the present supplies of irrigation water can be made to go much further.

It is suggested that the solution of the first problem will be found in the extended growth of *shaftal* (*Trifolium resupinatum*) (1) and similar leguminous crops like lucerne, berseem (*T. alexandrinum*), senji (*Melilotus indica*) and guár (*Cyamopsis psoraloides*), but that no great extension of the leguminous fodder crops is possible unless they can be dried and baled and sold to advantage. On this account trials of baled *shaftal*, by the Quetta Garrison, were initiated and developed, which showed that by the use of such fodders the weight of forage taken by an army on active service can be reduced by 25 to 30 per cent. Once the Army comes into the market for

(1) See also R. August, 1917, No. 726.

These dried fodders, their extended use is certain and both cattle and horses underfed and overworked in urban areas could be improved.

For famine reserves, these baled fodders would be of great use. The water necessary for the extended growth of leguminous fodder crops could be saved by the adoption of water-saving methods in the growth of wheat and gram (*Cicer arietinum*), the most important crops in North-West India. Good crops of wheat were obtained by a single watering, instead of the 6 or 7 irrigations now given by the zamindars. This single irrigation should be applied about a week before sowing the wheat and everything should be done to conserve the moisture. This watering enables a good deep-rooting crop of wheat to be obtained and carries on the crop till the winter rains are received. These are conserved by breaking up all crusts with the lever harrow as soon as the land is dry enough. Proceeding in this manner the average experiment Station yields of wheat on large areas, with one watering, are nearly 18 maunds to the acre.

Studies on the Digestibility of some Vegetable and Animal Fats. — LANGWORTHY, C. F. and HOLMES, A. D., in *United States Department of Agriculture, Bulletins* Nos. 505 and 507, each 19 pp. + tables. Washington, D. C., Feb. 13, and March 24, 1917.

The digestion experiments with both vegetable and animal fats were conducted by the same methods, so that the results are directly comparable. The basal ration (supplying a minimum of fat) composed of wheat biscuits, oranges, sugar, and tea or coffee, was supplemented by a blanc-mange or corn starch pudding, in which was incorporated the vegetable or animal fats under investigation. The test periods were of three days' or nine days' duration followed by a rest period of four days in which the subjects, normal young men in good health and moderately active, could eat anything they liked.

Weighings were made of the net amount of food eaten and faeces excreted, and samples of both food and faeces were analysed to determine the percentages of protein, fat and carbohydrate which were actually digested. The detailed results of these analyses are given in a series of tables.

CONCLUSIONS WITH REGARD TO VEGETABLE FATS: With allowance for metabolic products, the coefficients of digestibility have been found to be, for olive oil, 97.8; for cottonseed oil, 97.8; for peanut oil, 98.3; for coconut oil, 97.9; for sesame oil, 98; and for cocoa butter, 94.9 per cent. These values indicate that the vegetable fats studied, with the exception of cocoa butter, have for all practical purposes the same digestibility, and are utilised as completely as the animal fats.

The melting points of these fats are considerably lower than body temperature (37° C.) and, in accordance with the theory that fats of low melting points are more thoroughly digested than the harder fats, it has been found that the vegetable fats studied, with the exception of cocoa butter, are utilised practically completely by the body.

The average amounts of fat eaten per subject daily were 73 gr. of olive, 64 gr. of cottonseed, 98 gr. of peanut, 64 gr. of coconut, and 90 gr. of sesame

oils. The limits of tolerance were considerably higher than this, though less for cocoa butter than for the other fats studied.

The digestibility of protein and carbohydrate contained in the different fat diets was not materially affected by the nature of the fat or by the amount eaten.

The total energy values of the material consumed on the average per man per day were 2 700 calories for olive oil, 2 955 calories for cottonseed oil, 2990 calories for peanut oil, 2 305 calories for coconut oil, 2 975 calories for sesame oil, and 2 215 calories for cocoa butter. The percentage of energy actually available to the body was 93.9 for olive oil, 93.4 for cottonseed oil, 93.9 for peanut oil, 93.1 for coconut oil, 92.8 for sesame oil, and 91.4 for cocoa butter.

Judging from the results of the investigation as a whole, it is reasonable to conclude that olive, cottonseed, peanut, coconut and sesame oils are very completely and readily available to the body and that they may, like the animal fats, be satisfactorily used for food purposes.

CONCLUSIONS WITH REGARD TO ANIMAL FATS: The fats studied in this investigation were well digested, the coefficients of digestibility with allowance for metabolic products and any undigested fat supplied by the basal ration, being as follows: chicken fat, 96.7 %; goose fat, 95.2 %; brisket fat, 97.4 %; butter fat in the form of cream, 93.8 %; the fat in egg-yolk, 93.8 %; the fat in fish flesh, 95.2 %.

On an average, 95 gr. of chicken fat, 95 gr. of goose fat, 80 gr. of brisket fat, 78 gr. of butter fat in the form of cream, 83 gr. of egg-yolk fat and 60 gr. of fish fat were eaten per subject per day. In the case of goose fat a distinctly laxative effect was noted, indicating that the limit of tolerance for this fat was not far above the 95 gr. which were eaten on an average. No physiological disturbance was noted with the other fats tested.

The average coefficient of digestibility of brisket fat is higher than that previously found for beef (kidney) fat (93 %) which is in accordance with the observation that the digestibility is inversely proportional to the melting point.

The consumption of fat did not exercise any unusual effect upon carbohydrate digestion.

As a whole the experiments have shown that the above mentioned fats are all well assimilated and are satisfactory sources of food for the diet. Butter fat in the form of cream and egg-yolk fat being particularly valuable.

792 - **The Maple Sugar and Syrup Industry Schools of Quebec Province in Canada.** SAVOIE, F. S. (Secretary Provincial Department of Agriculture of Quebec), in *The Agricultural Gazette of Canada*, Vol. 4, No. 7, pp. 591. Ottawa, July 1917.

The three maple sugar-making schools established in 1914 by the Department of Agriculture of the Province of Quebec at Ste. Louise, Beauville, and La Minerve, were worked during the month of April. The seasonal results are given in the following comparative table:

Sugar making schools	No. of maples tapped	Gallons of sap gathered	Lbs. of sugar made	Gallons of syrup made	No. of pupils	No. of visitors
La Minerve	3 000	19 500	55	492	7	38
Ste. Louise	4 500	18 580	175	484	44	240
Beauceville	3 000	16 400	—	319	5	170

The cost of manufacturing has been higher than usual, on account of cold temperature and the long sugar season; prices obtained were much lower than usual. Syrup of first quality sold for \$1.50 to \$1.75 per gallon of sugar from 14 to 16 cents per pound.

In reply to a large number of requests five instructors, provided with necessary apparatus, visited several sugar-houses, giving 49 demonstrations in manufacturing and explaining the methods. The demonstrations attended by 1297 persons from 76 different counties.

CROPS AND CULTIVATION.

Studies on the Palaeozoic Soils of North Wales. — ROBINSON, G. W. (Adviser in Agricultural Chemistry, University College of N. Wales, Bangor), in *The Journal of Agricultural Science*, Vol. VIII, Part 3, pp. 338-384, 2 figs., IX tables, Cambridge, June 1917.

Studies made by the writer in field and laboratory upon the soils derived from material of the Pre-Cambrian, Cambrian, Ordovician and Silurian formations in Anglesey, Carnarvon and Denbigh. This paper is of exceptional interest as, but for the researches of the writer in Shropshire, little or no work has been done on the Palaeozoic soils. The bulk of the experimental work on soils in England has been on soils of Jurassic and later strata.

These researches bring out clearly the differential characters of each of the soils investigated. In mechanical composition it will be noticed that, with the exception of sands, alluvia and peats, the soils of this area are loam texture. The high proportion of silt and fine silt renders these soils sticky when wet, but on drying they are generally quite friable. It is probable that their friable nature on drying is due to the high proportion of organic matter present. Sedentary soils and soils derived from local flint deposits contain remarkably high proportions of fine gravel, which, in the subsoil, may amount to 40 per cent. Microscopic analysis of the coarser fractions obtained in mechanical analysis show that they are mainly fragments of undecomposed parent rock; this is further confirmed by the low silica content as determined by chemical analysis, and in consequence, the soils in question must be placed in the category of Ramann's *Steinboden*, i.e., soils consisting chiefly of slightly decomposed rock fragments.

The North Wales soils are generally deficient in calcium carbonate, in spite of this, however, nitrates can be detected in most of them. It would therefore appear that a type of farming has developed which dispenses with lime.

The high figures for organic matter are readily explained. On the one

hand, the humid climate with its mild winters favours vegetative growth while on the other, the absence of calcium carbonate hinders aerobic decomposition and promotes anaerobic changes.

Further, the poor aeration of the soil consequent on the interstitial spaces being occupied by water, encourages anaerobic decomposition in which a "sour" peaty humus is produced. The amount of potash present is generally rather high; the same may be said for phosphoric acid.

The Palaeozoic soils of North Wales differ very much from the soils hitherto studied in England. Their agricultural treatment — involving comparatively long periods under grass alternating with arable cultivation — together with the climate, must be considered in devising schemes of manuring and soil treatment. A considerable amount of experimental work in field and laboratory would therefore appear necessary in order to discover to what extent the results of English experiments can be applied to the treatment of North Wales soils.

794 — **The Shrinkage of Soils in the Leeward Islands, British West Indies.** — THOMAS H. A., (Government Chemist and Superintendent of Agriculture for the Leeward Islands) in *The Journal of Agricultural Science*, Vol. VIII, Part. 3, pp. 312-330, fig. 1-4. Cambridge June 1917.

The writer has studied quantitatively the contraction produced in soil when it is allowed to dry after having been compacted in a moist condition. These investigations were specially made from the point of view of cacao growing on certain soils in the West Indies. The method of attacking the problem consisted in determining the linear contraction of a block of soil by means of a special apparatus.

The writer measured a rectangular block of soil before and after drying and expressed the final linear contraction that took place as a percentage of the original length, when the block contained the water necessary to give the soil its maximum of plasticity. Several determinations were made with 5 typical soil samples from different parts of the Leeward Islands: — a heavy, slightly calcareous clay loam — a heavy non-calcareous loam — a medium non-calcareous loam — a moderately light, non-calcareous loam — a light, non-calcareous loam.

If it is admitted that in soils which have been moistened to the point of maximum plasticity, the whole of the water exists in union with the colloidal material present in the soil in the form of a gel, and that this gel occupies the interstitial spaces, and draws together the soil particles as it loses water by evaporation, the normal relation between contraction and water loss appears to be that the cubic contraction (1) is equal to the volume of water evaporated from a given quantity of soil. This equality only exists until internal friction among the soil particles restricts the contraction. In fact, in normal soils, a point is reached at which this internal

(1) In accordance with the formula:

$$C = \left(3a - \frac{3a^2}{104} + \frac{a^3}{104} \right)$$

where C is the cubic contraction in % and a the linear contraction in %.

tion offers sufficient resistance to the contracting gel to cause a progressively increasing departure from the normal relationship. The point at which this departure occurs and the magnitude of the total shrinkage appears to be a function of the amount of colloidal clay contained in any particular example.

It was found on calculating the pore space of the soil (1) that there is a regular increase in pore space corresponding to a decrease in the linear shrinkage, and, by means of a graphic calculation, it was estimated that the maximum shrinkage in pure colloidal clay is about 23 per cent.

On this assumption, it becomes possible to calculate the approximate content of colloidal material in any soil from a knowledge of the linear shrinkage. Since the bulk of the colloidal material is contained in the fine silt and clay fractions, the writer tested the validity of this calculation for a fine silt and clay soils and for other soils in the Leeward Islands. It must, however, be noted that by the ordinary method of physical analysis it is difficult to determine the exact amount of the colloidal content of a soil, since the colloidal material is contained in the four fractions designated as fine silt, clay, and organic matter.

3. **The Influence of Soil Conditions on the Decomposition of Organic Matter in the Soil.** — RUSSELL, E. J. and APPELVARD, A. (Rothamsted Experimental Station), in *Philosophical Magazine*, Vol. VIII, Part 3, pp. 385-417, figs. 1-9. Cambridge, June 1917.

The biochemical decomposition of plant residues and other organic matter in the soil is of fundamental importance for soil fertility. Though, in large part, the decomposition is brought about by bacteria and other microorganisms in the soil, no definite connection has been traced in the field between the activity of the microorganisms and the extent of the change. The writers decided that the best means of studying the connection was to follow the development of the bacteria and the decomposition on given plots of ground during a long period. They therefore followed for 3 consecutive years the changes in amount of nitrate in the soil, of carbon dioxide in the soil air and of bacterial numbers on 5 plots of ground at the Rothamsted Experimental Station. The plots were as follows: 1 unmanured fallow plot — 1 dunged fallow plot — 1 dunged, cropped plot — 1 unmanured cropped plot — 1 manured and farmed in the ordinary way.

There is sufficient resemblance between the curves for bacterial numbers, carbon dioxide (except for a period on cropped land) and nitrate to justify the conclusion that they are all related. The curve for nitrate is always behind that for bacterial numbers, the lag amounting to 2 or 3 weeks. This would seem to indicate that there are 2 stages in nitrate production; these stages are not simply ammonia production and then nitrate production, but apparently the ammonia production is also divided into stages. On the other hand, the biochemical decompositions in the soil are determined in the first instance by the temperature and do not proceed

(1) According to the formula $P = \frac{D_1 - D_2}{D_1} \times 100$, where P is the pore space in %, D_1 the true density and D_2 the apparent density of the soil.

to any notable extent below 5° C. As soon as the temperature rises action begins rapidly, but it soon slows down and other factors begin to operate. Moisture is one of these factors, and it was found that action came to a minimum when the moisture fell to 10 per cent. by weight of the unmanured soil and 15 per cent. by weight of the dunged soil. Rainfall is an even more important factor, a shower of rain having notable effect in starting the decompositions. It seems probable that the dissolved oxygen in the rain is an important factor here. The growing crop (whether potatoes or oats) exerts a depressing effect on the decomposition, though whether by taking up the dissolved oxygen, by giving out carbon dioxide, or by some other action, is not clear. The fluctuations in bacterial number are not wholly explicable as functions of the temperature and moisture content; in fact some of the rises and falls are of the kind obtained during the investigations on partial sterilisation. Further work on this problem is at present being carried out at the Rothamsted Laboratory.

796 - **Irrigation in Various States and Colonies.** — BORGHESEANI, G. A. R., *Commissario Reale per studi e proposte relative ad opere d'irrigazione, seconda Relazione presentata al Parlamento dal Presidente Onorevole Giuliano Grasso, Senatore*, Part. 3, pp. I-VII + 175, 2 map., Bergamo, 1916.

This monograph is a study on irrigation in various countries, especially in arid and semi-arid districts.

The introduction, after general historical and geographical considerations, gives the physiographical bases of a comparative study of irrigation works, taking, as point of departure, the division into arid, semi-arid, semi-moist and moist districts proposed by WINTERTON. In the first place it is seen that 35 % of the earth's surface receive less than 500 mm. of annual atmospheric precipitation. These form the arid or semi-arid districts, which, in order to be cultivated, require special treatment, either irrigation or dry farming. Moreover, part of the semi-moist districts, with an atmospheric precipitation of 500-1000 mm., also require irrigation or means of preserving the water on account of the uneven distribution of the precipitation during the year. It thus happens that 65 % of the earth's surface, that is to say, 87 millions of square kilometers (1) have a minimum of water. It is, however, estimated that it is possible to irrigate only 13 500 000, or about $\frac{1}{10}$, of the total land surface. Of this, 7 million square kilometers are already under irrigation, leaving 6 500 000 square kilometers yet to be irrigated.

From a point of view of irrigation the different countries have been classified as follows:

a) countries in which irrigation is *obligatory*; these include countries with an atmospheric precipitation below 250 mm. and where cultivation can only be carried out by means of water brought from outside. These countries are situated in the desert or sub-desert districts where the geographical and tectonic conditions allow water to be brought from great

(1) 1 sq. kilometer = 0.386 square mile.

stances or great depths. Egypt and the desert oases are typical of these lands.

b) countries in which irrigation is *necessary*; these include the semi-arid lands with 250 to 500 mm. of atmospheric precipitation. It is in these countries that irrigation gives the best results and is generally employed, for it is easy to bring the water from superficial streams or underground beds. Here irrigation is the indispensable complement of dry-farming, that is to say, that, in these districts, both dry farming and farming by means of irrigation are found. Countries typical of these conditions are: the western United States; Algeria and Tunis; Spain; Australia; South Africa; Chili; Argentina and Peru; and such should also be the semi-arid districts of Italy, western Liguria; Sardinia; Sicily; Basilicata; Apulia and other districts of the Adriatic;

c) countries in which irrigation is *supplementary*; these include the sub-moist districts with atmospheric precipitation of 500 to 750 mm., in which, theoretically, there is sufficient water, but where, owing to the bad distribution of the precipitations in the different seasons, either dry farming or farming by irrigation are useful. These countries are either intermingled with or bordering on those of the preceding groups, although they are sometimes in contact with the following category; such are, for example, certain districts of north eastern Germany; the south-west of France; a great part of central Italy, of Australia and of the United States, etc.;

d) countries in which irrigation is *optional*; under this heading come the moist districts where irrigation is usually practised for special intensive crops. Types of these are: the rice-fields of southern Italy, of the south-western United States, of Siam, of Cochin China, of China, of Japan and of the Dutch Indies; the "marcite" of Lombardy; numerous suburban districts where horticulture and arboriculture are carried out intensively.

In order to illustrate the subject under discussion the text is accompanied by an *edometric planisphere of irrigation*, in which the globe is divided into 4 large districts: — arid, semi-arid, sub-moist and moist, giving the political divisions in which public provision with regard to irrigation is made.

The irrigation of various countries is then described, special attention being given to countries which represent specific types of irrigation of arid and semi-arid districts. The countries studied are: Argentina; Germany; Austria; Hungary; Belgium; Chili; China; Cuba; Denmark; Egypt; Spain; United States; France; Algeria and Tunis; Madagascar; Indo-China; United Kingdom; Australia; Canada; Ceylon; India; South Africa; Japan; Mexico; Dutch East Indies; Peru; Russia; Siam; Switzerland.

The last part summarises the general principles laid down in the chapters on each country, and it is shown that the technical progress and application of irrigation are gradually attracting more and more the attention of statesmen, especially in those countries where agricultural production is most urgent, and where water forms the decisive factor.

In conclusion the following principles for the irrigation of arid zones in general are given:

- 1) the utilisation of superficial, sub-soil and deep waters by all the means in the power of modern technology ;
- 2) technical State assistance in the utilisation of the various water reserves suitable for irrigation ;
- 3) Financial State aid for irrigation work if private capital cannot find immediate interest ;
- 4) an appropriate distribution of the reserve waters suitable for domestic, agricultural and industrial uses, so that its use for the last purpose shall not be detrimental to the other two more important ones ;
- 5) technical assistance given to those engaged in irrigation farming so that they may make the most economical use of the water at the disposal ;
- 6) the institution of homesteads for those engaged in irrigation farming as this is the only method which will allow the maximum economical utilisation of the water ;
- 7) the recognition, with the requisite support, of all irrigation works and enterprises which have been neglected by competent technical bodies to be of public utility.

An appendix gives a bibliography of 643 works.

797 - **The Fixation of Nitrogen in Faeces.** — RICHARDS, E. H. (Rothamsted Experimental Station), in *The Journal of Agricultural Science*, Vol. VIII, Part. 3, pp. 299-311. Cambridge, June 1917.

In the course of a general study of the chemical changes taking place in the manure heap, a number of experiments were made with the object of determining the loss of nitrogen during the aerobic fermentation of urine, straw and faeces ; in the case of the last, however, instead of a loss of nitrogen, appreciable gains were recorded, and this decided the writer to devote special attention to the subject of this article.

He states in the first place, that horse faeces contains material capable of fixing nitrogen when fermented aerobically in presence of sufficient moisture and calcium carbonate. This fixation is a function of the diet, for when horses are fed on grass alone, instead of oats and hay, the amount of nitrogen fixed is much reduced. Under the most favourable circumstances 1 gram of dry matter in the faeces will fix 4 mgms. of nitrogen. Bullock faeces will also fix nitrogen, but to a much smaller extent than horse faeces. This is also a function of diet, for it only occurs when the animals are fed with cake ; on grass alone, no nitrogen is fixed.

The writer has found that the organisms concerned in the fixation of nitrogen are present in garden soil. Fixation is brought about by a mixed culture of *Azotobacter* and *B. lactis aerogenes*. Of these, the latter is normally present in faeces, and though *Azotobacter* is not, it readily infects faeces. The inoculation of faeces with both organisms fixes a considerable amount of nitrogen which disappears after sterilisation. Raw faeces, when inoculated with soil, also fixes nitrogen ; this fixation power was retained after sterilisation in the autoclave in some experiments which gave the greatest increase in nitrogen. It therefore seems probable

the nitrogen fixation is only a last link in a chain of biological changes brought about by organisms normally present in the faeces or soil.

The practical importance of this fixation is probably small; at most means that when a soil is manured with horse dung, there is a possible fixation of atmospheric nitrogen, which may amount, under the most favourable conditions, to 30 per cent. of the nitrogen in the complete manure.

On the other hand, the discovery might be of practical use in increasing the nitrogen of the soil, by fixing atmospheric nitrogen on industrial products containing actual or potential food for organisms of the type live in horse faeces.

Water Hyacinth (*Eichornia Crassipes* Solms.) and its Value as a Fertiliser.

— FINLOW, R. S. (*Fibre Expert to the Govt. of Bengal*) and MCLEAN, K. (*Deputy Director of Agriculture, Eastern Bengal*), in *The Agricultural Journal of India*, Vol. XII, Part III, pp. 419-424. Calcutta, July, 1917.

Eichornia crassipes Solms, belonging to the Family Pontederiaceae, native of South America, but has now become a troublesome weed in our countries, notably Florida, Java, Australia and India where it seriously interferes with river navigation. It is a herb which multiplies extensively by division of the root-stalk. In Burma it has been described as one of the greatest administrative problems at present confronting the Government.

The plant has been examined from the point of view of its agricultural possibilities and results have been obtained of considerable importance.

The following is an approximate analysis of the fresh plant :

	Per cent.
Moisture	65.50
Organic matter (Nitrogen, 0.04 %)	3.50
Ash (Potash, 0.20 % — P_2O_5 , 0.06 %)	1.00

The analytical figures indicate that the rotted water hyacinth is about as rich as farmyard manure, of the same water content, in nitrogen, phosphoric acid and lime, but contains several times as much potash.

The ash is about 1 % of the fresh green weight and its approximate content of important constituents is as follows :

	Per cent.
Potash	22.7
Soda	1.8
Lime	12.8
Phosphoric acid	7.0
Chlorine	21.0

The chlorine in the above is just enough to combine with the whole of the potash, and therefore the sample contained nearly 50 % of its weight as chloride of potash.

Field experiments have shown that the rotted plant applied as manure has a remarkable effect upon the jute crop, giving an increase over the usual of six maunds (480 lbs.) of fibre, worth Rs. 50 per acre. 500 maunds

(40000 lbs. or about 18 tons) of the green plant will supply the following approximate amounts of plant food:

	lbs.
Nitrogen	20
Potash (K_2O)	80
Phosphoric acid (P_2O_5)	35
Lime	60

Obviously, owing to its bulk and high water content, the wet hyacinth could not be economically transported over large distances. The dried plant is the only convenient form for transportation and contains from 1.5 % to 2 % of nitrogen and from 20 % to 25 % of ash, including about 8 % of potash (K_2O).

Messrs. Shaw, Wallace and Co. of Calcutta, have offered to buy any quantity of hyacinth ash at Rs. 4 per unit of potash (K_2O) landed in Calcutta. This is equivalent to from about Rs. 84 to Rs. 120 per ton of the ash.

799 - **The Solubility of Calcium Phosphates in Citric Acid.** — RAMSAY, A. A. Chem. Laboratory, Department of Agriculture, Sydney, N. S. W., in *The Journal of Agricultural Science*, Vol. VIII, Part. 3, pp. 277-298. Cambridge, June 1917.

These experiments were made by the writer in order to determine the extent of the solubility of phosphates in 2 per cent. citric acid. He states in the first place, that the substances sold as "Phosphate of Lime" and "Calcii Phosphas" B. P., are mixtures of di-calcic and tri-calcic phosphates. This mixture is always obtained when calcium phosphate is prepared by precipitation with ammonia.

Pure tri-calcic phosphate is only obtained when 3 equivalents of lime are made to act on 1 equivalent of phosphoric acid, the resulting phosphate being removed with little delay.

If the tri-calcic phosphate thus obtained is treated with a 2 per cent. citric solution in the ordinary manner for 30 minutes, 91 per cent. of the phosphoric acid becomes soluble, but, if calcium carbonate is added, the solubility of the phosphoric acid is reduced to 84.4 per cent. by the addition of 14 per cent. of lime as carbonate, while the further addition of 14 per cent. of lime as carbonate reduces the solubility to 84.3 per cent.

Since the whole of the excess of lime, beyond that present as tri-calcic phosphate, goes into solution in the first 30 minutes of extraction with 2 per cent. solution of citric acid, the latter is more correctly a solvent of lime than for phosphoric acid. Pure tri-calcic phosphate is largely soluble in 2 per cent. citric acid, as are also the so-called di-calcic and tri-calcic phosphates produced by precipitation in presence of ammonia. It therefore follows that since di-calcic and tri-calcic phosphates are both soluble in the prescribed 2 per cent. citric solution, the statement that di-calcic phosphates can be differentiated from tri-calcic phosphates by means of the selective action of this solvent is untenable.

Therefore the manurial value of phosphates cannot be determined by a 2 per cent. citric acid solvent in the method prescribed and it is a matter for consideration as to whether the further use of this method should be continued.

o - **The Resistance of Wheat to Cold in Relation to its Sugar Content; Investigations carried out in Sweden.** — **ÅKERMAN, A.** and **JOHANSSON, H.**, in *Sveriges Utställnings Tidsskrift*, Year 27, Pt. 2, pp. 77-83, Malmö, 1917

During the last 10 years it has been proved that the resistance of plants to low temperatures is due, in part at least, to the presence of sugars (saccharose, glucose, mannite, etc.) in the cell sap. With regard to the Gramineae, **ÅSSNER** and **GRIMMER** have observed that the water extract of autumn wheat seedlings gives a much stronger reaction with Fehling's solution than the water extract of spring cereals treated with the same reagent.

The experiments described were undertaken to determine whether the various degrees of resistance to cold of the principal Swedish wheats really depended on a more or less strong concentration of the sugars in solution. Three series of experiments were made of which the analytical results are included in the 3 tables given below: — I. Young plants, analysed immediately after picking after having been treated with ether. — II. Young plants, analysed after having been dried at 70° C. — III. Young plants, analysed after soaking in ether during several days.

1st. Series. — Wheats studied. — "Tystofte Smaahvede II" and "Svenligt Sammetsvede" ("Landtvede"); the latter is characterised by a marked resistance to low temperatures.

TABLE I. — Results of the 1st. Series of Experiments.

Varieties	Dry matter in percent of fresh matter	Glucose in percent. of dry matter								
		I			II			III		
		Minimum	Maximum	Average	Minimum	Maximum	Average	Minimum	Maximum	Average
masbreds II.	23.0 %	8.5%	9.0%	8.8%	7.2%	8.7%	8.0%	9.4%	10.4%	9.8%
sammetsvede	25.5	16.0	17.4	16.7	17.7	18.4	18.0	18.5	19.4	19.0

It is seen that the resistance to cold of the "Sammetsvede" variety is accompanied by double the quantity of glucose contained in the "Smaahvede" variety.

2nd. Series. — Besides the 2 preceding varieties "Sol" wheat was also studied. This variety is a little more resistant to cold than "Smaahvede" but rather less so than "Sammetsvede", with a glucose content intermediate between these two varieties, as is seen by Table II.

In this 2nd. series the material dried at 70° C. contains the least reducing sugars, and the material soaked in ether for several days before analysis contains the most.

3rd. Series. — To the above varieties was added "Thule II" wheat, obtained by crossing "Sammetsvede" × "Pudel". In all experiments in various parts of Sweden this wheat had proved more resistant to cold than "Sol" but less so than "Sammetsvede".

TABLE II — Results of the 2nd. Series of Experiments.

Varieties	Dry matter in percent of fresh Matter	Glucose in percent of dry matter								
		I			II			III		
		Minimum	Maximum	Average	Minimum	Maximum	Average	Minimum	Maximum	Average
Smaahvede II	19.6 %	7.4 %	8.1 %	7.5 %	6.3 %	7.1 %	6.7	7.7 %	8.3 %	7.9
Sol.	20.2	8.7	10.0	9.6	8.2	9.1	8.6	10.0	10.8	10.4
Sammetsvede	23.7	14.6	16.2	15.3	13.4	13.9	13.7	14.9	16.5	15.5

TABLE III. — Results of the 3rd. Series of Experiments.

Varieties	Dry matter in percent of fresh matter	Glucose in percent of dry matter								
		I			II			III		
		Minimum	Maximum	Average	Minimum	Maximum	Average	Minimum	Maximum	Average
Smaahvede II.	23.2 %	13.4 %	14.5 %	14.1 %	13.5 %	14.2 %	13.8 %	—	—	—
Sol.	23.8	15.3	16.1	15.7	14.8	14.9	14.8	—	—	—
Thule II	24.7	17.8	18.4	18.0	16.9	17.2	17.1	—	—	—
Sammetsvede	26.0	20.8	21.6	21.1	19.0	20.0	19.6	—	—	—

It is therefore seen that in all the cases examined a perfect parallelism existed between the resistance to low temperatures and the sugar content

801 - Temperature and Life Duration of Seeds; Experiments made in the United States. — GROVES, JAMES FREDERICK (Contribution from the Hull Botanical Laboratory 226), in *The Botanical Gazette*, Volume LXIII, No. 3, pp. 169-180, 5 fig. IV plates. Chicago, Illinois, March 1917.

In the appendix there is a bibliography giving 33 publications mentioned in the text of the article.

A study of the effect of high temperatures (from 50° to 100° C.) upon the life duration of seeds of wheat (Turkey-red variety) with a somewhat low moisture content (9 % — 12 % — 17.5 %).

An easily handled thermostat of simple construction is used. The seeds are placed, 100 at a time, in securely-corked test tubes which are plunged into a bath of water and alcohol in the inner vessel of the thermostat the temperature being regulated by an automatic electric apparatus. After the seeds are heated, they are removed from the thermostat and washed for 2 or 3 minutes in a $\frac{N}{20}$ solution of silver nitrate and then washed thoroughly in distilled water to remove the excess of silver nitrate. The seeds are germinated in large Petri dishes containing a layer of moist cotton wool covered with a layer of filter paper.

By determining the time required to kill seeds at any two definite temperatures, the time for killing seeds at any other temperature can be calculated by means of LEPEŠCHKIN's formula: $T = a - b \log Z$, in which T is the temperature in degrees centigrade, Z is the time in minutes, and a and b are constants.

If the loss of viability of seeds during storage is a matter of coagulation of cell proteins of the embryo, this time-temperature formula for the coagulation of proteins should be applicable as a temperature-life duration formula for seeds. To ascertain whether this was the case was the object of the present experiments. The results obtained were positive. In fact, the values found and those calculated by means of LEPEŠCHKIN's formula coincide within relatively small limits of error: 0.6 per cent. for 9 per cent. moisture: 0.8 per cent. for 12 per cent., etc.

The following is a summary of the most important results:

1) The life durations of wheat with 9 per cent moisture at the various temperatures are:

Temperatures	90.8° C	85.7°	84.2°	83.5°	79.8°	74.4°	70.8°	66.0°	60.6°	56.3°
Life durations (minutes)	8	27	45	63	140	435	810	2340	7200	19440

Thus, as the temperature diminishes, the resistance and life duration of the seeds rapidly increases: from 8 minutes at 90.8° C. to 13 1/2 days at 56.3° C.

2) The life durations for 12 per cent moisture are:

Temperatures	92.2°	87.7°	87.5°	87.5°*	84.4°*	84.4°	789.00	79.1°	78.5°*	75.8°	71.3°
Life durations (minutes)	7	8	9	10*	15*	18	45*	50	50*	120	315

* Values obtained in the experiment, but not used in the theoretical curve, as they show some variation.

The life durations for 17.5 per cent moisture are:

Temperatures	87.1°	83.6°	83.1°	79.3°	74.7°	70.5°	64.4°	60.6°
Life durations (minutes)	3.0	3.75	4	5.5	8.0	23.0	140.0	440.0

Thus, the temperature being the same, the life duration diminishes rapidly as the moisture content of the seeds increases.

Can the LEPEŠCHKIN formula be applied as a life duration formula for heat seeds at lower temperatures, including ordinary storage tempera-

tures? It would appear not, for the values obtained are much higher than those found by WHITE and other writers. This may be due to:

1) Increase of acidity of seeds, which at low temperatures hastens the coagulation of the cell proteins.

2) A slight error in the value of the constant b . The probability of this error increases as the temperature diminishes. If it were possible to estimate these causes of error and to allow for them, LEPESCHKIN's formula would certainly permit of a very approximate calculation being made of the life duration of cereals under ordinary storage conditions.

802 - **The Influence of Light on the Germination of the Seeds of Different Varieties of *Nicotiana Tabacum*.** — HOSING, J. A., in *Bulletin van het Deli Proefstation*, No. 7, pp. 1-14, Medan, December 1916.

According to RACIBORSKI (1) tobacco seeds do not germinate in the dark, a fact that is confirmed by experiments at the Deli Station. Therefore the writer was much surprised at GASSNER's (2) classification of seeds wherein he placed the seeds of *Nicotiana tabacum* in the group of seeds insensible to light. As he found 80.5 % germination both for seeds in diffuse daylight, as well as in darkness, probably there must exist large difference between the varieties of *Nicotiana tabacum* in the need of light for germination.

An experiment with many varieties proved this supposition to be true. Just as RACIBORSKI states, the Deli-tobacco cannot germinate without the presence of light, (or only a very small percentage germinates), and the differences between the seeds of different origin or plants are small. But there are some other varieties which germinate in darkness almost as well as in light, though somewhat more slowly.

Experiments were carried out with 51 samples of seeds, 8 of Deli tobacco, 6 of West or Central European types, received from Seidani, 11 samples of varieties from the Balkans and Asia Minor, also from Seidani, and 21 of American species received from Washington. 1 of *Nicotiana quadrivalvis* and 1 of *N. rustica*. As a rule types from the Balkans and Asia Minor are the quickest in germinating in darkness and give the highest percentages.

Of the American varieties, some do not germinate without irradiation, just as Deli-tobacco, and others germinate for a small percentage, not a single one coming above 50 %.

The types from West and Central Europe take, with one exception, an intermediate position.

Only the seeds of *Nicotiana quadrivalvis* agreed in their behaviour in darkness with the sample of *N. tabacum* used by GASSNER.

(1) RACIBORSKI, M., *Ueber die Keimung der Tabaksamen*. Lands Plantentuin Bulletin 2 l'Institut botanique de Buitenzorg No. VI, 1900.

(2) GASSNER, G., *Einige neue Fälle von keimungs-auslösender Wirkung der Stickstoffverbindungen auf Lichtempfindliche Samen*. Ber. d. d. bot. Ges. Bd. XXXIII, S. 217-232, 1915.

The Influence of Mineral Matter on the Germination of Peas (1). — MAQUENNE, L. and DEMOUSSY, E., in *Comptes rendus des Séances de l'Académie des Sciences*, Vol. 165, No. 2, pp. 45-51. Paris, July 9, 1917.

The influence of metallic salts on germination varying with the nature of the mixtures in which they occur, the writers have determined the action which each single salt exercises when alone and dissolved in perfectly pure water.

In Table I, the weights indicate the absolute quantities of active substance regarded as anhydrous which have been added to the water moistening the sand, that is to say, placed at the disposal of 10 seeds; the aluminium was administered in the form of potash alum.

TABLE I. — Length (in mm.) of the roots after 24 hours' soaking and 6 hours' germination.

Salts employed	Weight of active substance						
	0 mg.	0.10 mg.	0.25 mg.	0.50 mg.	1 mg.	2 mg.	5 mg.
	Length of roots						
calcium chloride	26 mm	26 mm	25 mm	26 mm	26 mm	33 mm	41 mm
barium chloride	23	23	24	24	23	24	25
ammonium sulphate	26	26	25	26	31	33	36
barium sulphate	30	42	58	79	74	75	78
potassium chloride	25	31	36	36	35	44	34
barium chloride	26	28	33	31	26	25	19
ammonium sulphate	27	25	27	30	34	35	32
barium sulphate	24	24	24	24	20	19	17
ammonium sulphate	27	30	30	30	39	42	49
ammonium sulphate	26	26	27	34	34	33	24
barium chloride	25	26	26	26	24	17	15
barium sulphate	26	26	24	25	17	14	16

It can be seen that, apart from the case of calcium, which is exceptional, the differences remain fairly slight up to the proportion of 0.05 mg. of salt per seed, corresponding to, $1 \frac{1}{2500}$ of its dry weight; however, the general facies of the seedlings distinctly changes when one passes from one metal to another.

Calcium appears to be the only body which, in the absence of all others, is capable of ensuring the normal germination of peas at the outset. With a proportion of 0.01 mg. per seed of the sulphate or chloride, which corresponds to 0.003 mg. of the metal, i. e., to about $1 \frac{1}{40000}$ of the weight of the dry seed, the length of the roots increases by nearly one half and absorbent hairs begin to appear. Its action, therefore, begins to make itself

(1) See R., August 1917, No. 417.

felt in extraordinarily small proportions, inferior to those in which the majority of poisons begin to produce an effect. M. COUPIN (1) has shown that calcium salts in excess hinder the formation of hairs on the roots of *Lupinus sativum*. On comparing this statement with those of the present work there are grounds for concluding that the production of root hairs is, the part of calcium, a proof of favourable action and thus also of a proportion suited to the needs of growth. On the other hand their checked development and a fortiori their absence constitute a proof of poisoning in an excess proportion.

Vegetable matter possesses a powerful affinity for lime which is one of the indispensable factors for the beginnings of plant life. The seed does not contain in itself a proportion of lime sufficient for its needs. Analysis of the seed from the point of view of alkaline earths only gives the results shown in Table II.

TABLE II. — Analysis of seed (alkaline earths).

Proportion per cent. of seeds	Total ash per cent.	Lime per cent.		Magnesium per cent.		Absolute weight per seed		
		of ash	of organs	of ash	of organs	of organs	Lime	Magnesium
11.52 %	2.80 %	19.90 %	0.56 %	13.92 %	0.39 %	14.50 mg	0.081 mg	0.051
88.48	2.95	1.51	0.04	7.81	0.23	112.00	0.050	0.159
—	2.93	3.53	0.14	8.49	0.25	126.58	0.131	0.16

In proportions less than those in which they are toxic and in the conditions of the actual experiments, the harmful metals did not favour the growth of the roots.

After calcium, at the rate of 0.05 mg. per seed, at which proportion the toxic elements employed do not produce any effect, there come strontium, manganese, aluminium, barium and magnesium much less favourable than the alkaline metals, zinc, lead and copper, which seem to have no immediate effect.

This study of the development of the roots is to be followed by another on that of the stems.

804 — The Influence of Hot-Water Treatment on the Germination Percentage of the Seeds of *Albizzia moluccana* Miq., *Pithecolobium saman* Bth., *Mimosa invisa* Mart. and *Crotalaria striata* D.C. — HOKING, J. A., in *Bulletin van het Deli* Proefstation No. 7, pp. 15-24. Medan, December 1916.

The hard seeds of *Albizzia moluccana*, *Pithecolobium saman* and *Mimosa invisa* can be forced to germinate by treating them with hot water. The use of boiling water, however, as recommended for *Albizzia* by some authors, is very disadvantageous; sometimes all the seeds are killed; and even 80° or 70° C. is too high when the temperature decreases slowly and remains at this height for half an hour or more.

For *Albizzia* the best water temperature for soaking the seeds is about 60° C. Fresh hard dried seeds may stand 70° C. very well; but 60° C. is sufficient and for older seeds far better.

(1) Cf. *Comptes rendus de l'Académie des Sciences*, Vol. 164 1914, p. 641.

Seeds put in water at 80-100° C. showed a higher percentage of germination on filter paper than in sand. Nevertheless most of them were so much damaged that, after pushing out the root top through the seed coats, the seeds were not able to grow further and died. Seeds, soaked in water at lower temperature or not soaked at all, germinated better in sand.

The best results with *Pithecolobium* seeds were obtained by using water 70° C., thus 10° C. higher than for *Albizzia*, and even 80° C. gave a higher percentage than 60° C. The *Pithecolobium* seeds are more resistant against water and need a higher temperature.

The *Mimosa* seeds also showed the highest percentage of germination after treatment with water at 70° C.; but 80° C. is harmful and gives a small proportion (13 3/4 % in sand) than 60° C. (40 3/4 % in sand). Without water treatment the germination is very bad, even in sand, at best 10 %.

Crotalaria seeds are damaged by all temperatures above 50° C. The influence of water of 50° C. was quite the same as that of 27° C., in both cases seeds germinated in sand 38 1/4 %, on filter paper 51 1/2 and 50 1/2 %. Without previous soaking the results in sand were better, 32 1/4 and 26 1/2 on filter paper. Hot water is very injurious in this case.

5 - The Fertilisation of Gramineae and Leguminosae in Relation to Selection. — FRANDSEN, N. H. (Director of Experiments at Oloftegaard, Province of Toastrup, Denmark), in *Zeitschrift für Pflanzensichtung*, Vol. V, Pt. 1, pp. 1-30. Berlin, March 1917.

This paper describes work carried out at the Experimental Station of Østøfte (Denmark) on species of Gramineae and Leguminosae, in order to determine, by observing the course of flowering in plants which flower freely and by experiments on the isolation of the flowers or inflorescences: 1) to what degree self-pollination and self-fertilisation can occur in these species; 2) to what degree self-fertilisation or cross-fertilisation may eventually occur when these plants flower freely. The experiments were carried out during the summers of 1910, 1911, and 1912 with the following species: *Dactylis glomerata*, *Festuca pratensis*, *Lolium italicum*, *L. perenne*, *Phleum pratense*, *Alopecurus pratensis*, *Poa fertilis* Host, *Bromus arvensis*, *Trifolium pratense*, *Lotus corniculatus*, *Medicago sativa*, *M. lupulina*. The investigations of T. WESTERMANN on *Dactylis glomerata*, *Phleum pratense* and *Bromus arvensis*, as well as other publications on the subject studied, have been taken into consideration. In order to isolate the Gramineae parchment or cotton bags or glass cylinders were used and, to isolate the Leguminosae, bags of thin gauze.

The following methods of pollinisation were used for the Gramineae:

- 1) Pollination in the same plant (pollination by the neighbour, "geitonogamy") with isolation of one, two, or several inflorescences at the same time.
- 2) Pollination by the pollen of another plant (cross pollination) either by common isolation of two or more inflorescences of the same plant and by suspension of the flowering ears or panicles of other plants, or else by common isolation of two or more inflorescences of various plants.
- 3) Free pollination (for comparison with the self-pollinised and cross-pollinised inflorescences) on plants flowering freely without being subject to any outside influence.

For the Leguminosae the methods used were :

- 1) Natural self-pollination (properly speaking).
- 2) Artificial self-pollination with pollen : a) of the same flower (self-pollination, properly speaking); b) of another flower of the same inflorescence (pollination by the neighbour "geitonogamy"); c) of another inflorescence of the same plant (also pollination by the neighbour).
- 3) Artificial cross-pollination (artificial pollination by the pollen of another plant and, for *Lotus corniculatus* ;
- 4) Artificial hybrid pollination by the pollen of a plant of another principal type.

The flowering and fertilisation conditions of each of the above-mentioned Gramineae and Leguminosae are studied, and tables are given of 1) the results of the pollination experiments ; 2) the number of inflorescences removed ; 3) the total number of their flowers and seeds ; 4) the percentage of the average relation between flowers and seeds ; 5) the average variation. In some of the tables concerning the Gramineae (for example, *Phleum pratense*, *Alopecurus pratensis*), the weight of the inflorescences and seeds during the different years of the experiment is also given. The table concerning *Lotus corniculatus* also includes the average length of the pods and the number of seeds either entirely or partly developed within them.

The results of the investigations are summarised as follows :

I. GRAMINEAE. — The results obtained from *Dactylis glomerata*, *Lolium perenne*, *L. italicum*, *Phleum pratense*, *Alopecurus pratensis*, agree with those of other workers, and confirm the supposition that these Gramineae are cross-fertilised species. Nevertheless, in the case of panicles tied up separately, and in that of two panicles of the same plant tied up together, higher figures were obtained for fructification, as much as 11.5 % of fruit being obtained in the first case and as much as 11.2 % of fruit in the second, according to the total number of flowers. Tying up panicles of different plants together always gave much higher figures.

Dactylis glomerata, *Phleum pratense*, and *Alopecurus pratensis* showed marked individual differences in their weak fecundity when self-pollinated or pollinated by a neighbouring plant.

In the case of *Poa fertilis* and *Bromus arvensis*, Gramineae whose flowering and fertilising conditions had not been previously studied, it was found that (contrary to that of the 6 above-mentioned Gramineae) almost normal fructification occurs both when the panicles are isolated and when many panicles of the same plant are tied up together.

II. LEGUMINOSAE. — In *Trifolium pratense* it was found that self-pollination, pollination with flowers of the same head, and pollination with flowers of another head of the same plant give such a slight fructification (if indeed it prove at all productive) that it must be attributed to chance circumstances.

On the other hand, *Medicago sativa*, when pollinated artificially or naturally, gave a better fructification than that claimed for it by other workers.

Lotus corniculatus proved very slightly susceptible to self-fertilisation by natural or artificial pollination in the heart of the same flower.

Good fructification was obtained with *Medicago lupulina* with inflorescences tied up separately and plants tied up in the same way. KIRCHNER's statement that the perennial form is less fertile than the annual form was, however, not confirmed.

Selection of Spring Wheat in Sweden. — NILSSON-EHLE, H., in *Sveriges Utödebrönnings Tidskrift*, Year 28, Pt. 2, pp. 51-76. Malmö, 1917.

Until recent years it was thought that there existed a negative correlation between earliness and yield, the one diminishing as the other increased. Results obtained lately with winter wheats show that these two characters develop, and are transmitted, independently of each other, at least up to a certain point.

In the northern climates, especially in Scandinavia, it is important to select wheats which combine the 2 characters "earliness" and "productivity". The selection and hybridisation experiments carried out at the Svalöf Station (Sweden) and at its branches, aimed at creating types of spring wheat at which should be both very early and very productive. The results obtained from these experiments from 1911 to 1916 are given below:

1) Variety "0840-0841 Svalöfs Extra Kolben" — "Kolben" × "0201" varieties "Värpär" and "0201" are obtained, by individual selection, from "Emma" wheat. The second variety is more productive than the first (12% more in 1907), but is not of practical use because of the low quality of its grain (angular and badly formed, weighing relatively little per bushel). In order to unite in one type the productivity of "0201" with the earliness and good quality grains of "Kolben", these two varieties were crossed. From the many hybrids was isolated the line 0840-0841, called "Svalöfs Extra Kolben", and which is highly valuable from every point of view. From 1911 to 1916 a series of comparative cultural experiments was carried out at Svalöf with this wheat; the results are given in the following table:

Results of comparative cultural experiments at Svalöf from 1911 to 1916.

Variety	1911	1912	1913	1914	1915	1916	Average	Relative Index
Yield of grain in cent. per acre.								
0841 Extra Kolben	24.92	22.70	26.98	17.04	25.88	21.26	22.25	114
1	22.14	18.08	28.26	16.23	26.28	19.51	21.82	107
0201 Kolben	22.40	18.08	21.32	8.62	22.06	20.86	20.47	100
Diff.	22.92	17.20	21.96	16.64	25.96	20.31	21.18	104
Weight in lbs. per bushel.								
0841 Extra Kolben	—	59.22	63.78	65.95	62.98	59.94	62.34	—
1	—	57.21	62.74	63.06	60.82	56.65	60.10	—
0201 Kolben	—	60.42	63.70	66.11	62.02	59.94	62.10	—
Weight in ounces of 1000 grains.								
0841 Extra Kolben	1.283	1.297	1.364	1.196	1.046	1.079	1.206	—
1	1.352	1.405	1.587	1.286	1.361	1.361	1.407	—
0201 Kolben	1.213	1.202	1.305	1.156	1.002	1.079	1.150	—

In all years, whether cold and late as 1912 and 1916, or warm with early spring as 1911 and 1914, the new variety always exceeded even "0201" in yield. This was certainly due to its greater earliness, for, in the years 1914 and 1915, when climatic conditions were particularly favourable (and with consequently, great earliness was not required), the variety "0201" gave a yield about equal to that of the variety "0840-0841 Extra Kolben". In the cultural experiments at Malmöhus this last variety gave the following comparative results.

Variety	Yield of grain in cwt. per acre	Relative Index
0840-0841 Extra Kolben	25.72	114
Vårpärl	22.62	100
Svalöfs Kolben	22.54	100

It is thus seen that the new variety surpassed the other two by 14% Outside Scania, in Östergötland, Halland and Uppland, it also gave promising results.

Variety	Yield of grain in cwt. per acre	Relative Index
0840-0841 Extra Kolben	17.68	112
Vårpärl	—	100
Svalöfs Kolben	15.87	100

The following characteristics may be noted: — 1) Strength of culms as in "Svalöfs Kolben"; 2) Earliness equal to this variety, for, during the 6 years 1911-1916, the "0840-0841 Extra Kolben" variety was only one day later than "Svalöfs Kolben" in earing and 1 1/2 days later in ripening. 3) Quality of grain excellent, weighing as much per bushel as Svalöfs Kolben and more than "0201"; moreover its small size (see weight per 1000 grains) allows a great saving in sowing without affecting the yield. The new variety "0840-0841 Extra Kolben" gives the following combination scheme with regard to the characters of the parents "0201" and "Svalöfs Kolben":

	0201	0840-0841 Extra Kolben	Svalöfs Kolben
Yield in grain	+	(+)	—
Earliness	—	(+)	+
Weight per bushel	—	+	+
Size of grain	—	+	+
Resistance of culms	—	+	+

This new variety, which so advantageously unites the best characters of the two parents while eliminating the negative characters, will be put on the market in 1918 and may be used with assured success in all districts where "Svalöfs Kolben" is grown: Skåne, Halland, Gotland, Östergötland, Västergötland. Its yield, exceeding by 14% that of "Svalöfs Kolben".

"0804" combined the most productive wheat, gives it, in selection, a free of success never hitherto attained.

2) Variety "0804 Svalöfs Vårskarshead" = "Varparl" × "0201". By crossing "Värpäl" with "0201" many hybrids were obtained, there was a marked absence of uniformity and it was only with great difficulty that a variety — "0804" — which could be advantageously used, isolated. It gave the following comparative yields:

Variety	Yield in grain in cwt. per acre		Relative Index
	I	II	
0804	23.73	108	
Värpäl	22.38	102	
Svalöfs Kolben	21.90	100	

In grain yield, then, the variety "0804" is slightly inferior to the variety "Extra Kolben" (see above), but it is distinguished by the elasticity and length of its culms (resistance to lodging), which make it suitable to very deep soils very rich in humus.

3) Variety "0880" = "Dalavårhvetet" × "Svalöfs Kolben". — "Kolben" and "Extra Kolben" varieties are too late for central Sweden. In order to obtain a spring wheat adapted to this district, "Kolben" wheat was crossed with the "Dalavårhvetet" native wheat so as to unite in one plant the earliness of the one variety with the resistance to rust characteristic of the other. The line "0880" is derived from this crossing and appears to fulfill the desired requirements. It gave the following comparative yields (2 series of experiments):

Variety	Yield of grain in cwt. per acre		Relative Index	
	I	II	I	II
0880	19.35	18.87	108	109
Kolben	18.00	17.76	100	103
Dalavårhvetet	—	17.28	—	100

The following other characters of the new variety may be noted: — It ripens 4 days earlier than "Kolben", but 1 day later than "Dalavårhvetet"; 2) Straw as strong and as resistant as that of "Kolben"; 3) Resists well. It shows the following combination scheme with regard to the characters of the parents:

	Kolben	0880	Dalavårhvetet
Productivity	+	+	—
Earliness	—	(+)	+
Resistance to rust	+	(+)	—
Resistance of culms	+	+	—

"0880" is, therefore a valuable new variety for central Sweden, more especially so if the work now in progress allows the weight per bushel to be increased.

The experiments described all gave positive results. The other experiments may be summarised as follows:

4) "*Schlanstedter*" \times "*Värpärä*" cross carried out to unite the productivity of this German spring wheat with the earliness of "*Värpärä*" wheat.

5) Interesting series of crossings between "*Sol*" autumn wheats and "*Kolben*" spring wheats. The F_1 hybrids have the character of spring wheat. In the F_2 generation $\frac{1}{4}$ of the hybrids have the character of autumn wheat and $\frac{3}{4}$ the character of spring wheat. In the following generations $\frac{1}{4}$ the latter preserve and transmit the spring wheat character while $\frac{3}{4}$ continue to break up into spring and autumn types in the simple Mendelian ratio of 3 : 1.

6) Cross between "*Extra Kolben*" and "*Halländskavårhvete*" (Norwegian *Holland* spring wheat). Although the varieties obtained up to the present unite in satisfactory proportions and with equally satisfactory results the characters "productivity" and "earliness", it is not impossible to obtain subsequent improvements. This is the result aimed at with this crossing: the "*Extra Kolben*" variety already surpasses the "*Kolben*" variety by 14 % in yield of grain; if it were possible, by a new cross, to bring this up to 20-25 %, the position of spring wheats in Swedish rural economy would be very greatly improved.

807 - Hybridisation Tests between Spelt and Wheat in Holland. — G. MELIN, H. MATH in *Culture*, Year 29, No. 345, pp. 140-158, 2 plates. Wageningen, May 1917.

Common wheat (*Triticum sativum* *tenax vulgare*) and spelt wheat (*Triticum sativum* *Spelta*) are two varieties of *Triticum* showing such great anatomical and morphological differences that, till lately, they were considered two distinct species: *Triticum vulgare* (wheat) and *Triticum Spelta* (Spelt). The lack of affinity between these two varieties gives a particular interest to all hybridisation experiments. On the other hand, the attempt to unite in one and the same type the productivity of the best wheats with the resistance to cold of spelt may lead to practical results very useful to the development of the cultivation of cereals in Holland. The experiments were begun while the author was studying under GILTAY, interrupted, and taken up again in 1907 at the Agricultural Institute of Wageningen. Beardless red-glumed spelt ("roode ongebaarde spelt") was chiefly used, and "Essex" hairy-glumed wheat ("fluweelkaf Essexstarwe").

The spelt has the following characteristics: 1) long ears with spikelets far apart; 2) smooth red glumes; 3) red caryopses; 4) inflorescence axis very slender, breaking when threshed. The characters of Essex wheat are: 1) long ears with spikelets close together; 2) white glumes covered with hairs; 3) white caryopses; 4) inflorescence axis strong and elastic. The F_1 hybrids showed: 1) red glumes covered with hairs; 2) coloured caryopses; 3) thickness of spikelets intermediary to that of the two parents.

During the tests the plants to be hybridised were grown in pure lines and all technical precautions (wide sowing, tying up of the inflorescence, etc.) were taken to avoid the apparition or intrusion of impure or new characters. In 1916 a very careful Mendelian analysis of the F_2 generation was made: the colour of the glumes and caryopses, the presence or absence of hair

the glumes studied, and certain conclusions drawn with regard to the transmission of the character "density of spikelets". The F_2 plants were derived from 3 different hybridisations and formed a total of 4189 plants divided as follows:

Hybridisation	Number of plants in F_2
I. — Red beardless spelt, plant No. 1 \times Essex, plant No. 1 . . .	1341
II. — Essex, plant No. 2 \times Red beardless spelt, plant No. 3 . . .	1409
III. — Essex, plant No. 3 \times Red beardless spelt, plant No. 2 . . .	1439

The presence or absence of hairs on the glumes and the colour of the anthers and caryopses (white or red) allow the hybrids of F_2 to be distinguished and grouped fairly easily. In doubtful cases, which sometimes occur in determining the colour, the plant examined is not included in the calculation.

Table I summarises the results of the Mendelian analysis. These results are afterwards discussed.

TABLE I. — Results of Mendelian analysis of F_2 .

	Number of plants in F_2	Plants with hairy glumes	Plants with smooth glumes	Plants with red glumes	Plants with white glumes	Plants with red caryopses	Plants with white caryopses	Plants with glumes of doubtful colour
I	1 341	989	352	1 007	334	1 324	17	140
II	1 409	1 042	367	1 146	263	1 388	21	135
III	1 439	1 075	364	1 153	286	1 402	27	148
Total	4 189	3 106	1 083	3 306	883	4 114	65	423

1) *Hairy glumes (FF) and smooth glumes (ff)*. — Table II, which gives the number of plants of each of these two types, shows a very satisfactory agreement between the numbers found and the numbers calculated. There is evidently a ratio 3:1 between these types, showing that it is a question of mono-hybridism with dominance of the character "hairy glumes".

If F represents the genetic factor determining the presence of hairs, and the factor determining the absence of hairs, Essex wheat may be represented by the formula FF, spelt by ff, and their hybrid of the 1st. generation by the genetic formula Ff. This hybrid produces two kinds of sexual cells, F and f, which, in the 2nd. generation, may form the following 4 groups: — 3, Ff, Ff, ff; in other words, in the 2nd. generation there will be $\frac{3}{4}$ hairy-glumed plants and $\frac{1}{4}$ smooth-glumed plants.

2) *Red glumes (BB) and white glumes (bb)*. — As in the preceding case, the ratio between these two types is 3:1, and the number of plants found agrees well with the number calculated.

TABLE II. — *Hairy glumed and smooth glumed plants in F_2 . Comparison between the numbers found and the numbers calculated.*

	Numbers found		Numbers calculated	
	Hairy glumed plants	Smooth glumed plants	Hairy glumed plants	Smooth glumed plants
I	989	352	1 005.75	335.25
II	1 042	367	1 056.75	352.25
III	1 075	364	1 079.25	359.75
Total	3 106	1 083	3 141.75	1 047.25

3) *Red caryopses and white caryopses.* — In the F_2 the ratio between plants with red caryopses and those with white caryopses is 63 : 1, corresponding to a tri-hybrid. The difference in colour between red spelt and Essex wheat is, therefore, due to 3 distinct Mendelian unities R_1, R_2, R_3 , of which one alone suffices to determine the red colour. Spelt may, then, be represented by the formula $R_1R_1 R_2R_2 R_3R_3$, wheat by $r_1r_1 r_2r_2 r_3r_3$, and the hybrid of the 1st. generation by $R_1r_1 R_2r_2 R_3r_3$. This hybrid produces 8 different sorts of sexual cells: $R_1R_2R_3, R_1R_2r_3, R_1r_2R_3, R_1r_2r_3, r_1R_2R_3, r_1R_2r_3, r_1r_2R_3, r_1r_2r_3$, so that, in the 2nd. generation, there are 64 possible combinations, of which one only, $r_1r_1r_2r_2r_3r_3$, has white caryopses. The ratio between plants with red caryopses and those with white caryopses is, therefore, 63 : 1.

4) *Density of the spikelets.* — The author has so far been unable to obtain analytical data as exact as in the preceding cases. Nevertheless, some of his conclusions are worthy of note because they contradict in part the hypotheses hitherto put forward on this subject. Spelt has long ears with few grains, Essex wheat, relatively short, compact ears, whereas the F_1 hybrids show characters intermediary to these two. In the F_2 are found: plants of intermediary character, plants with the characters of the parents, and finally a fact which is both interesting and remarkable, *stable forms with ears still more compact than those of Essex wheat*. In another set of experiments the author also obtained forms with compact ears by crossing spelt with "Gelder I" wheat with lax ears.

These results suggest the following considerations:

a) According to NILSSON-EHLE, the character "*compactum*" is due to the presence of a factor C which determines the shortness of the internode. This factor predominates over those of length - $L_1 L_2$ — which it dominates absolutely, so that a plant with the formula $CC L_1L_1 L_2L_2$, and a plant with the formula $CC l_1l_1 l_2l_2$ will always have an equal quantity of compact ear. According to NILSSON-EHLE this factor will always be found only in type with compact ears, never in the others, whereas the author obtained form

th compact ears by hybridising beardless red spelt with "Gelder I" wheat, both with lax ears.

b) According to NILSSON-EHLE, the factor *C* is purely inhibitory and negative, and the only action it exerts is to prevent the other factors from showing their effects. How then is it possible, in the 3rd generation (F_3) explain the appearance of plants with ears much more compact than those Essex wheat? In this case, on the contrary, the factor *C* seems to exert directly determinative, positive action.

8. Experiments in Hybridizing Wheat and Rye in the United States. — I. I. EIGHTY, C. E. Carman's Wheat-Rye Hybrids, in *The Journal of Heredity*, Vol. VII, No. 9, pp. 420-427, 5 fig. Washington, September, 1916. — II. MCFADDEN, EDGARD A., Wheat-Rye Hybrids, *Ibid.*, Vol. VIII, No. 7, pp. 335-336, 1 fig. Washington, July 1917.

I. — It appears that the first cross between wheat and rye was effected by A. S. WILSON of Edinburgh (Scotland) who presented his results, April 1875, in a communication to the Botanical Society of Edinburgh, without however giving any illustration of the hybrids obtained. The plants were sterile, so the hybrid was not carried further than the first generation.

About 1877, E. S. CARMAN turned his attention to improving wheats: 1) by selection; 2) by changing spring into winter wheats; 3) by crossing; 4) by hybridizing wheat and rye. He seems not to have known of Mr. WILSON'S work.

In the *Rural New Yorker* of August 30, 1884 is shown what is probably the first illustration ever published of a hybrid between wheat and rye secured by CARMAN. This hybrid produced a few seeds from which experimentation was continued and from the progeny of which a variety was produced and disseminated. A head of Armstrong wheat, a beardless variety known as Landreth, and now called Martin Amber, was selected for the female parent. In this head, 10 more or less imperfect kernels formed. Of these, 9 germinated. Although the resulting plants differed from one another in ear length, the colour of the glumes and of the straw, 8 of them showed only wheat characters without any trace of rye. For this reason, the writer is of opinion that CARMAN was mistaken in regarding them as hybrids. The ninth plant obtained, and which is given in the above-mentioned figure, is on the other hand, clearly a hybrid of wheat and rye. This is shown by the shape and general appearance of the head, the arrangement and number of spikelets, the glume characters and the culm. The latter resembled that of rye except in colour, having the whitish down near the head which never appears in wheat. This plant bore 10 heads which produced 19 kernels, thus being nearly sterile. From these seeds, however, 14 plants were obtained, these produced altogether 107 heads (from 2 to 13 per plant) and showed great variability. Rejecting all inferior heads, enough grain was saved from the best to plant a plot of $\frac{1}{20}$ (or $\frac{1}{30}$) acre. The new crop varied remarkably and was entirely different from either wheat or rye. Heads 7 inches long were not uncommon and some bore compound spikelets. Other heads were scarcely 2 inches long. CARMAN continued his experiments: he tried to fix selections from the wheat-rye hybrids until 1902, at which date he introduced 3 new varieties: Nos. 1, 4 and 52; the two

first were considered as wheat \times rye hybrids, and the last as a pure wheat cross. From the data given, it cannot be ascertained whether the two first were actually descended from the true wheat-rye hybrid. In 1894, two further introductions of wheat varieties were made, No. 57 and No. 6. The first did not originate as a cross with rye, but the latter is a true rye wheat hybrid and a variety of it bearing the name of Rural New York No. 6 is now included among the wheat varieties of several experimental stations of the United States.

CARMAN continued the crossing of the wheat-rye hybrids with rye for 2 successive generations; one head, F_1 pollinated with rye pollen in 1898 gave, under a form F_2 , 17 kernels which resulted in 14 plants. These were nearly all sterile and the F_3 was completely sterile, which put an end to the work.

These experiments therefore show that crossing wheat and rye is possible, but difficult; that the hybrids show great variability, characters appearing which are not present in either of the parents; that the 2nd. cross with rye is almost sterile, and the 3rd. cross completely barren.

II. — During the last 3 years, the writer has been engaged in work much resembling that of CARMAN. He aimed at obtaining a winter wheat which could resist the severe frosts of Dakota. He thus chose the most resistant types of wheat and rye, the Turkey and Swedish varieties. 9 heads of the former, on being pollinated with pollen from the latter, only produced 9 kernels, a maximum of 3 per head. Two only germinated, and produced a wheat plant, the other gave rise to a true hybrid though much resembling wheat. In culm length and the number of spikelets per head, the hybrid was intermediate between its 2 parents. It was remarkably vigorous. The first heads it formed had anthers without pollen. Some of the later formed heads were pollinated with pollen from the Kharkow variety of winter wheat and 3 kernels were thereby obtained. These produced 2 plants but they died during the winter 1916-17 which was exceptionally severe. The writer intends continuing his experiments. The figure given in this article shows very clearly that the hybrid head is intermediate between those of its parents.

809 — **Experiments on the Artificial Hybridisation of Rice in Java.** — KOCK, L. I. *Teysmannia*, Year 27, Pt. 9 and 10, pp. 502-519. Batavia, 1916.

The advantages of selection by hybridisation are first summarised in an introduction, then the results obtained by applying this method to rice at Buitenzorg (Java), are described.

Among the varieties of rice cultivated in this district are: — "Karna Serang", a native of Carolina, characterised by its earliness and the good quality of its grain (heavy and bulky), and "Skrivimankotti", a native of Suriman, well-known for its high yields. In 1907, VAN DER STOK undertook hybridisation experiments with these two varieties in order to unite in one and the same type the productivity of "Skrivimankotti" and the high quality grain characteristic of "Karna Serang". Selection from the hybrids of the 2nd. generation (F_2) was begun by isolating those plants which best corresponded to the type aimed at in order to derive new lines from

m. At the beginning the results of these experiments were not very satisfactory owing to the heterogeneity and lack of stability among the progeny. s may, perhaps, be explained by the co-existence of *many* determinants *one* character, which tend to diminish the number of and the opportunities combinations showing the value. A further proof of this is the appearance he hybrids of new characters found in neither of the parents, as, for exam- black or pink awns, whereas "Karang Serang" has white awns and krivimankotti "none at all.

It was only from 1913 onwards that some of the hybrids of the "Skrivimankotti" type began to show a certain uniformity and stability, an obvious 1 that hymozygosis had been reached, at least for certain characters.

Below are given, for some of the hybrids obtained; 1) the weight per in; 2) the yield of paddy per acre. The corresponding figures for the ck-plant "Skrivimankotti" are also given.

	Weight per grain	Yield of paddy
	mgr.	tons
Stock plant "Skrivimankotti"	31.05	1.80
Hybrid No. 1	30.01	2.09
Hybrid No. 2	34.74	1.94
Hybrid No. 3	34.46	1.80
Hybrid No. 4	33.01	1.97

These hybrids, which surpass "Skrivimankotti" both in the quality their grain and in yield, correspond fairly well to the desired end. The Karang Serang" variety is still superior with regard to the weight per in (37.23 mgr.), but it is quite possible that by selection and hybridisa- on still better gametic combinations may be obtained.

The most efficacious method of hybridisation is as follows: — cut the p of the glumes with scissors a few hours before flowering, then remove the thers with a fine needle, pollinate a few hours after with the pollen of ano- er plant. It is not necessary to reclose the hybridised flowers, but the micles are enclosed in a gauze envelope, which is protected at night and ing rain by a little cover of dry leaves.

By this method the author, in one case, obtained 43.3 % of successes. n the other hand, the results were sometimes less good, or even negative, ven the difficulties inherent to this method of hybridisation, and were rely dependent on the condition of the pollen at the time of pollination.

10 - Experiments with Small Grains (Wheat, Barley and Oats) Under Irrigation in Idaho, United States. — WELCH, J. S., in *University of Idaho Agricultural Experiment Station, Gooding Sub-Station, Bulletin* 93, 24 pp. Moscow, Idaho, January 1917.

In 1909, the Office of Irrigation Investigations of the United States epartment of Agriculture and the Idaho Experiment Station established e Gooding Sub-Stat on for experimental work in the irrigation of farm oys. The Station is a tract of 40 acres located 2 miles south of the wn of Gooding on the great Snake river plains at an elevation of ap- roximately 3600 ft. The Bulletin analysed is based upon the results of

experiments conducted at this Station during the years 1909 to 1916 inclusive. The writer gives the following summary:

The small grain crops are of great importance on the irrigated farms of Idaho.

WHEAT. — Of all the spring varieties the soft white ones are best adapted for growth under irrigation. Dicklow is the leading variety grown under irrigation at this time. For average irrigation conditions, the durum wheats are not recommended.

In the irrigation of spring wheat, water can be used most efficiently in the early stages of the plants' development. If but one irrigation can be given, it should be applied just before the first jointing stage of growth. If water is withheld till the grain reaches the soft dough stage, it is of no value to the crop. The most satisfactory results were obtained at the Gooding Sub-Station by the application of one irrigation just before the first jointing and another between the first jointing and the blooming stage. In the growth of spring wheat it is not advisable to apply a total of more than one and one-fourth acre-feet of water per acre.

Winter wheats can be grown to advantage on irrigated lands; perhaps to best advantage in those sections where irrigation water is not plentiful. On the Station farm the best varieties have proved to be "Jones' Fife" and "Turkey Red". In the irrigation of winter wheat, one irrigation of slightly less than three-fourths of an acre-foot of water per acre, given just before heading was found to be sufficient. The average yields obtained at the sub-station by means of irrigation are given in Table I.

TABLE I. — *Performance Record of Irrigated Wheats.*

Name	Time from seeding to maturity in days	Average height of plants in inches	Yield per acre		Weight of grain a pounds per bushel
			Grain in bushels	Straw in tons	
<i>Soft spring wheats:</i>					
Marquis.	114	45	53.2	1.96	60
Dicklow.	117	47	46.1	1.86	59
College Hybrid No. 143	114	43	43.8	1.74	62
Saskatchewan Fife.	114	43	41.6	1.86	59
Defiance.	117	46	39.4	1.89	60
Palouse Bluestem	114	45	37.6	1.97	58
Galgalos.	111	38	35.3	1.55	64
<i>Spring wheats, durum type:</i>					
Pellissier.	109	46	39.8	1.91	63
Kubanka	109	47	38.3	1.91	63
Purple Durum	109	45	32.2	1.98	64
<i>Winter wheats:</i>					
Jones' Fife	272	45	53.6	1.78	62
Turkey Red.	275	45	52.4	1.88	61
Koffold	276	49	42.8	1.57	61
Missouri Red Fulz.	272	55	40.5	2.06	61

TABLE II. — *Performance Record of Irrigated Barleys.*

Name	Grain per acre bushels	Straw per acre tons.
Trebi	95.5	1.61
Beldi No. 1209*	87.3	1.46
Sandrel	82.9	1.46
Bohemian	84.21	1.69
Horn	81.65	1.94

* Centener numbers of the Californian Experiment Station where this variety and also 101304 were originated.

BARLEY. — Of the six-rowed type Trebi, Beldi and Sandrel were the varieties which gave the highest crops under irrigation. The best varieties of the two-rowed type were "Bohemian" and "Horn". Eureka was the best of the hullless type.

For irrigating spring barleys about $1\frac{1}{2}$ acre-feet of water should be applied per acre. Under normal irrigation winter varieties of barley are not nearly as productive as the spring-sown ones. Winter barley should be irrigated just before the appearance of the ears and only about $\frac{1}{2}$ acre-foot of water applied per acre.

OATS. — A large number of the varieties of oats are very productive. The best from this point of view are Swedish Select with 96.6 bushels of grain per acre and 1.63 tons of straw per acre, and Wisconsin Pedigree No. 1 with 96.5 bushels of grain and 1.69 tons of straw per acre. Oats do not require more than $1\frac{3}{4}$ acre-feet of water per acre.

11 — "Kafir" and "Milo" Sorghum as Grain Crops and Fodder Crops in Arid Soils. Experiments made in the Argentine. — VILLALBA, ABRAHAM, in *Ministerio de Agricultura de la Nación, Dirección general de Enseñanza e Investigaciones agrícolas, Sección Enseñanza extensiva, Boletín No. 46*, pp. 32, 6 plates. Buenos Aires, 1916.

With the exception of the most important varieties (*halapensis*, *saccharatum*, *scoparium*), the cultivation of sorghum as a fodder and grain crop is unknown in the Argentine. The author wished to test its suitability for the arid, dry-wind beaten districts of the southern part of the Republic. These districts are not suited to the cultivation of wheat or maize and are largely uncultivated. The experiments were carried out in various districts in collaboration with the farmers, and those made at Vilelas, in the centre of the Chaco of Santiago del Estero are specially described. Three varieties were used: 1) white kafir with black glumes; 2) "colorado", or red, kafir; 3) yellow milo. They were all sown on maize stubble, the soil being prepared by two consecutive harrowings; a PLANET cultivator was used. The yields per acre were: — white kafir with black glumes, 28 $\frac{1}{2}$ cwt; red kafir, 29 $\frac{1}{4}$ cwt; yellow milo, 39 $\frac{3}{4}$ cwt.

The milo ripened 8 to 10 days before the kafir and, in other districts as well, gave a higher yield than kafir.

The advantage of sorghum lies in its great vitality; if it be destroyed by the teeth of animals, locusts, or other causes, it produces new shoots and still yields a harvest. Moreover, the grain ripens before the culm, and when

it is harvested there remains an excellent and abundant yield of fodder. By sowing sorghum early, that is to say, in August or in September, one or two crops of green fodder and one or two crops of grain are obtained, according to whether, at the first harvest, the culms are cut low. Sorghum is very sensitive to frost. It does not encroach on the land and has very few enemies, the most harmful of which are birds.

The cultivation of non-sugar sorghum in the arid soils of the Argentine is strongly advised for the following reasons :

1) The above-mentioned varieties are more resistant to drought and hot winds than either maize or wheat ;

2) Their cost price is less and their yield greater than those of maize or wheat. The following table is based on the average cost price and average unit yield for maize and wheat throughout the Republic, and for kafir in the Chaco Santiagueño :

Cost Prices and Unit Yields of Wheat, Maize and Kafir.

Expenses	Wheat	Maize	Kafir
	£. s. d.	£. s. d.	£. s. d.
Preparation of the soil, sowing, cultivation, etc.	2. 4. 0	1. 15. 2	1. 15. 2
Rent of ground	0. 17. 7	1. 0. 4	0. 8. 0
Threshing, sacks, transport	1. 4. $7\frac{1}{2}$	1. 19. $6\frac{1}{2}$	2. 12. 9
<i>Total expenses</i>	<i>4. 6. 2%</i>	<i>3. 1. 2%</i>	<i>4. 16. 9</i>
<i>Yield per acre</i>	<i>3 $\frac{1}{2}$ cwt.</i>	<i>18 cwt.</i>	<i>24 cwt.</i>

3) The food value of kafir flour is equal to that of wheat flour as the following table shows :

Analyses of kafir and wheat flours.

	Kafir flour	Flour of Santa-Fé Wheat
Moisture	12.06 %	14.10 %
Nitrogen	9.52	12.60
Fat	1.55	1.60
Fibre	2.60	0.60
Starch	73.47	70.50
Ash	0.80	0.60

In starch value kafir is inferior to one cereal only -- rice.

4) Sorghum replaces maize very effectively as a food for human beings, domestic animals and poultry.

5) In pig-breeding sorghum offers great possibilities on account of

cheap land (in the arid or semi-arid region of the Argentine ; 2) high yield grain; 3) low cost price.

6) The culms form an important supplement to green fodder; sometimes 2 crops of fodder and 2 crops of grain may be obtained per annum.

Shallu, a Variety of Sorghum, in the Great Plains, United States. — ROTHGESS, BERTON F., in *Farmer's Bulletin* 827, United States Department of Agriculture, 8 pp., 3 fig Washington, D. C., June 1917.

Many varieties of sorghum have been introduced into the United States the past 30 or 40 years; some of them have proved valuable under dry conditions in the southern Great Plains. Large, late varieties generally not be depended upon for grain production in this section, because of short and often partly unfavourable growing season. Early and mid-season varieties of dwarf or medium growth such as the early varieties, milo, erita and kafir give the best results. Shallu is not adapted to dry-land conditions, as it requires a long favourable season to mature. This is shown the Bulletin analysed which sets forth the results obtained with Shallu comparison with other varieties in varietal tests carried out at Texas, Oklahoma, Kansas and New Mexico.

Shallu was imported from India into the United States under the name "Egyptian Wheat" by the Louisiana Agricultural Experiment Station about 1890. Since then it has been distributed rather widely, particularly in the southern Great Plains.

It requires from 125 to 140 days to mature, and because of its late maturity is more likely to be injured by drought than the early varieties of milo and kafir. The large open heads are attractive and give the appearance of producing high yields, but, in reality, under the most favourable dry conditions, the yields are lower than those of kafir and milo, and in unfavourable years, shallu often fails entirely. In addition, the stalks are slender and easily blown down by storms, making the crop difficult to harvest. Because of its late maturity, shallu is more exposed to the attacks of the Sorghum midge (*Contarinia sorghicola* Coq.).

Experiments with shallu have been conducted at the Cereal Field Station, Amarillo, Tex., since 1905. This station has an elevation of about 4000 ft. and an average rainfall of about 21 inches.

The average yields obtained there during the period from 1911 to 1916 were: Shallu 10 bushels; Dwarf milo 27.4 bushels; feterita 21.8 bushels and Dwarf kafir, 19.3 bushels per acre.

At the Woodward Field Station at an elevation of about 1900 ft., and with an annual rainfall of about 24 inches, the average yield during the 6 years 1914-1916 was: Shallu 12.5 bushels; Dwarf milo 21 bushels; feterita 15.4 bushels and Dwarf kafir 20 bushels per acre.

- 813 - Experiments with Irrigated Legume Crops and Grass Pastures. -- WELCH, J. M.
 I. Experiments with Legume Crops Under Irrigation, in *University of Idaho Agricultural Experiment Station, Gooding Sub-station Bulletin* No. 94, 14 pp. 4 fig. Moscow, Idaho, January 1917; II. The Management of Irrigated Grass Pastures, *Ibid.*, Bulletin No. 95, 17 pp. 3 fig. Moscow, Idaho, January 1917.

I. The legume crops are among the most important for the irrigated lands of Southern Idaho. The principal leguminous plants grown are lucerne and clovers, upon which an extensive and growing livestock industry is based; clover seed, peas and beans (field peas are used in pork production). The use of all these crops in upbuilding and maintaining the fertility of the soil of this region has become one of the first principles of agricultural practice in the State. The work which has been conducted at the Gooding Sub-Station with the legume crops has consisted of the testing and comparison of varieties, experiments upon various phases of irrigation practice, and the seeding and cultural management of the most important of these crops. In the irrigation experiments, all water, both on-flow and run-off was carefully measured, all waste water being deducted from the amount supplied.

LUCERNE. Varieties. -- During the season of 1910, 11 varieties of lucerne were grown. Very irregular stands were secured, and therefore the data were obtained on the relative yields of the different varieties. The "common" lucerne, which is by far the most extensively grown in Idaho, usually consists of several varieties or strains.

Seeding. -- Under ordinary conditions, it was found by experiment that the best results came from sowing 12 pounds per acre. Heavier seedings produced thicker stands, while the seedlings were shorter and less coarse and came into bloom on an average 3 days later than those grown from the lighter seedings. Only 2 cuttings were taken; a better quality of hay was produced by the 12, 16 and 20 pound seedings than by the 4 and 8 pound seedings. Under ordinary conditions, with a properly prepared seed bed, and a sufficient moisture supply, it is waste of seed to use more than 12 pounds per acre. The best results were secured by sowing lucerne with a drill.

Irrigation. -- During the seasons of 1910 and 1912, experiments were made with a view of comparing the relative value of the corrugation and the flooding methods for the early irrigation of lucerne. On the plots that were irrigated by the corrugation method the furrows were 30 inches apart. The sowing was done on relatively dry soil and irrigated afterwards. Observations made on this test indicate clearly the superiority of the corrugation method of starting lucerne, as it prevents soil-baking, but later shows little advantage over the flooding method. On sandy soils and steeper slopes, however, the former system may still be valuable to prevent washing and to aid in an even distribution of the irrigation water.

The results of this work show that comparatively deep irrigations should be used for lucerne. Under conditions similar to those prevailing at Gooding, the lucerne should receive from $1\frac{1}{2}$ to $2\frac{1}{4}$ acre-feet per acre in order to secure 3 crops of hay per season. This amount of water can be applied

st in 7 or 8 irrigations. More water than the quantity indicated may produce a little more hay, but the increased yield will not justify the extra expense involved.

Seed production. — In general, much less water is required to produce lucerne seed than lucerne hay. The best results are obtained by light frequent applications of water, because they tend to maintain a uniform soil moisture content. The best crop was obtained from rows 35 in. apart.

CLOVERS. — Common red clover is the kind most grown. As regards irrigation, the same system is adopted for clover hay production as for lucerne hay. When grown for seed it is advisable to clip the first growth late in May and afterwards to apply light irrigations. Red clover is an especially valuable crop for use in building up the fertility of new lands.

Alsike and white clover are particularly valuable in pasture mixtures. When grown for seed, the first growth should be allowed to mature the seed crop.

PEAS. — The conditions prevailing in south Idaho favour the production of field peas; the best varieties are: Amraoti, Blue Prussian, Kaiser, and Angalia. The seeds should be sown at the rate of 90 to 100 pounds per acre. Early sowing is advisable. Under normal conditions, 2 irrigations give the best results. When mixed with oats, they make a satisfactory winter crop. They are extensively and profitably used in economical pork production in Idaho.

VETCHES. — *Vicia villosa*, or hairy vetch, is the most productive of the vetches. When grown with oats, it produces a heavy yield of excellent winter hay. The second growth can be used profitably as a green manure.

FIELD BEANS. — Of all the varieties tried, White Navy is the most satisfactory. Horse beans are valuable as a "hogging off" crop, but for this purpose they are not the equal of field peas.

The climatic conditions which prevail over many irrigated sections of south Idaho do not favour the production of soy beans and cow peas (*Vicia Catjang* or *Vigna sinensis*).

II. — During the last few years the interest in irrigated grass pastures has much increased in southern Idaho, where the conditions are well adapted to grass production. Of all the different grasses tested at the Gooding Experiment Station, the best varieties are: Orchard grass (*Dactylis glomerata*), smooth Brome grass (*Bromus secalinus*), Kentucky blue grass (*Poa pratensis*), Meadow Fescue (*Festuca pratensis*), and Timothy. Mixtures give better results than any variety sown alone. Different conditions require different mixtures.

A total of 20 to 24 lbs. per acre is sown. Grasses can be sown at any time from early spring to the latter part of July; autumn sowing is also advisable. Broad-casting the different varieties separately is the most satisfactory method of sowing. Sowing should be done on well prepared land and the seed covered lightly. Under average conditions, a nurse crop should not be used. From planting, until the grass comes up, the seed bed must be kept moist. The corrugation method is the best for the first season's irrigation; afterwards flooding is very satisfactory. Established pastures should

be irrigated about every 12 days, the amount of water applied at the Gooding Sub-Station being about 2.25 acre-feet per season. Pastures can be grazed lightly the latter part of the first season. Grazing tests have shown that one acre of good grass will properly maintain 2 good dairy cows or 3 beef steers, without any extra feed, from the end of April to the latter part of September. On an average, the steers gained in weight 732 pounds of beef per acre in one pasture season.

With regard to sheep, it was found that about 7 or 8 large ewes of the mutton breeds with their lambs can be properly maintained on 1 acre of irrigated pasture. It is advisable to divide the pasture into 2 or 3 parts.

814 - **Wild White Clover (*Trifolium repens*) for Artificial Grass Land; Trials in Different Parts of the United Kingdom.** — *The Journal of the Board of Agriculture*, Vol. XXIV, No. 4, pp. 424-428, London, July 1917.

The experiments carried out in various parts of the United Kingdom by GILCHRIST, JENKIN, MERCIER, MALDEN, M'ALPINE, PORTER, VOELCKER have definitively established the great value of wild white clover (*Trifolium repens*). It produces perennial plants and so gives better results than commercial white, or Dutch clover, which dies out more quickly. At Cockle Park (Northumberland County Agricultural Experiment Station) where extensive trials have been conducted, substantial benefits have been obtained from its use as early as the aftermath of the 1st. year's hay, and close clovery herbage now continues to be produced from the plant up to the 17th year after sowing.

It is a common experience that the inclusion of wild white clover in a seed mixture has established pastures of a high feeding value within 18 months after sowing, and has produced large crops of hay of high feeding value for some years in succession.

As regards manuring, the most satisfactory results have been obtained by applying 7 to 10 cwt. of high grade basic slag per acre in the autumn following sowing, after harvesting the cover crop. Dressings of dung or of nitrogenous manures develop the grassy herbage at the expense of the clovers, and therefore should not be used where it is desired to encourage wild white clover. On light soils known to respond to potash, a dressing

(1) GILCHRIST, DOUGLAS, A.: Wild White Clover, in *Farmers' and Stockbreeders Yearbook*, 1917. — Idem: Trials of Wild White Clover, in *Journal of Board of Agriculture*, Vol. XVI, No. 4, December 1909, and Vol. XXII, No. 11, February 1916. — Idem: *Annual Guides to Cockle Park*, 1906-16. — JENKIN, T. J.: Ordinary White Clover Seed versus Wild White Clover Seed, in *Journal of the Board of Agriculture*, Vol. XXIII, No. 12, March 1917. — MERCIER, W. B.: Grass and Clover Seeds, in *College Bulletin*, No. 15, Armstrong College, Newcastle-Upon-Tyne. — MALDEN, W. J.: Harvesting White Clover, in the *Farmer and Stockbreeder*, Vol. XXIX, No. 1, 1916, No. 7, 1916. — M'ALPINE, A. N.: Wild White Clover, in *Transactions of the Highland and Agricultural Society of Scotland*, Series V, Vol. XXVII, 1915. — PORTER, JOHN: A Big Step in Agricultural Improvement, in *The Hereford Times*, 1916. — VOELCKER, J. A.: A Report of Experiments Conducted in 1888 by Local Agricultural Societies in Conjunction with the Royal Agricultural Society, Saltney Experiments, in *Journal of the Royal Agricultural Society*, Vol. XXV, 1889.

alt (about 4 cwt. per acre) or potash manure should be applied in addition. If the land is mown for hay a further dressing of 8 cwt. of high-grade per acre, or its equivalent of low-grade slag, should be applied every year. If the land is pastured, 5 cwt. every third year is probably ample.

Wild clover is present to some extent on most pasture; it is also common on roadsides and on some types of hill-grazing. Most of the seed of this clover on the market at present is harvested on the Weald clay in the Counties of Kent, Surrey and Sussex. It has, however, also been successfully harvested in Gloucestershire and in many of the southern counties. Small lots have also been occasionally obtained from Wales and from Cumberland and other northern counties. The seed should be harvested from fields that have been down to grass for many years.

Poor pastures with very little grass are usually selected to provide the seed. These should be dressed with about 7 cwt. per acre of basic slag in autumn or early winter, and should be grazed over with cattle till the end of May in order to keep down the grass. The clover should then be cut for harvesting in August or September. Some growers treat it as an ordinary hay crop, but it should be handled gently and shaken as little as possible. The hay should be made into small cocks and care taken that it is not heat in the stack. To obtain commercially pure seed, it is necessary, after threshing, to use a special dressing machine. Farmers are generally satisfied with 2 to 3 cwt. per acre, although larger yields are not uncommon.

"Once Grown" wild clover has given quite satisfactory results. It is produced from leys in which true wild white clover is the only clover used in the seed mixture. The seed is harvested when the white clover has fully established itself, that is to say, after 2 or 3 years. It is of the greatest importance that the ley should receive no nitrogenous manures, but a good dressing of basic slag (10 cwt. per acre) should be applied after the corn has been harvested. The "Once Grown" wild white clover should be harvested in the same manner as the wild white clover.

The field should be grazed until about the 1st. of June and the clover cut in September. Some growers take an early cutting of grass and clover about the middle of June. In this cutting, the grasses will preponderate, but the second crop will produce chiefly wild white clover. The mixture sown to produce the seed of the "Once grown" clover should consist of about 4 lbs. of wild white clover per acre and suitable grasses for a 4 years' ley.

The seed of wild white clover is, on an average, much smaller than that of commercial white clover. Further, samples frequently contain a large percentage of "hard" seed (10 per cent. or more). These can be made to germinate by rubbing them lightly, or shaking them in a box lined with fine paper. The seed of natural wild white clover differs from that of the "Once Grown" clover in the proportion of impurities it contains. These consist chiefly of bird's foot trefoil (*Lotus corniculatus*) up to 5 per cent. — slow-sucking clover (*Trifolium filiforme*) up to 16 per cent. — crested dog's

tail (*Cynosurus cristatus*) — bent (*Agrostis vulgaris*) and sometimes the meadow grasses with pasture seeds like tormentilla (*Potentilla tormentillae*), wood-rush (*Luzula* spp.) and self heal (*Prunella vulgaris*). "Once Grown" wild white clover usually contains the seeds of self heal (*Prunella vulgaris*) and rib grass (*Plantago lanceolata*) with impurities like *Geranium* spp., madder (*Rubia* spp.) and bladder campion (*Silene inflata*), so often associated with temporary leys; it sometimes also contains a high proportion of red clover seed.

815 — **The Cultivation of Flax for Fibre in Canada.** — ADAMS, J., in *Dominion of Canada Department of Agriculture, Dominion Experimental Farms, Division of Botany, Bulletin No. 28*, 23 pp., 15 fig. Ottawa, 1916.

This bulletin was written for the use of practical agriculturists, and in order to promote the cultivation of flax in Canada, where it has already been grown successfully for a number of years in the Province of Ontario. In 1911, the area devoted to the crop in that province was 12 128 acres, but it decreased to 5334 acres in 1915. Flax has also been grown for fibre to some extent in the province of Quebec.

DR. W. SAUNDERS, Director of the Dominion Experimental Farms, has carried out a series of tests in growing flax for fibre in the different provinces of Canada and published an account of his work in Bulletin No. 59 of the above named institution in 1908. Dr. C. E. SAUNDERS has been engaged for a number of years in improving the varieties of flax by breeding from selected strains. Prof. C. A. ZAVITZ, of Ontario Agricultural College, Guelph, has experimented with a number of different varieties of flax in order to determine the best rate of sowing, and the yield per acre. He obtained the following results (averages 1905-9 inclusive):

Amount of seed sown (in pecks)	Height of crop (in inches)	Yield of Straw (in tons)	Yield of grain (in bushels)
1	29	1.55	14.0
2	29	1.68	15.2
3	29	1.96	18.6
8	28	2.24	19.0
12	27	2.35	20.2
16	26	2.24	18.0

Prof. ZAVITZ also carried on experiments with flax seed obtained from Ontario, Manitoba, Russia and Holland. His results (average) for the period 1905-11 were as follows:

Variety	Straw per acre (tons)	Grain per acre (bushels)
Manitoba	2.56	17.55
Ontario Common	2.54	16.42
Russian	2.32	14.99
Holland	2.31	14.94

The average weight of dry unthreshed flax straw for the province of Ontario is about 2 tons per acre. The average yields of flax seed per acre during the 5 years 1910-1915 were as follows:

Canada	11.27	busbels
Quebec	11.41	"
Ontario	16.44	"
Manitoba	12.18	"
Saskatchewan	11.17	"
Alberta	11.53	"

The crops, however, vary greatly in the same locality in different

years.

Brazilian Piassava. — TAVARES, J. S., in *Boletim, Serie de Vulgarização Científica* Vol. XV, Pt. 4, pp. 149-153. Braga, July 1917.

In Brazil the name "piassava" or "piassaba" is given to the two palms *Attalea junifera* Mart. and *Leopoldinia piassaba* Wall., as well as to the fibre obtained from them. The first is a native of the coast of the southern part of the states of Espírito Santo, Alagoas, and particularly of Bahia, of the Ilhéus district as far as Porto Seguro and Trancoso. The second is a native of Para and the Amazon district, where it covers large stretches of land, especially in the valleys of the Preto and Paduiry rivers and between the Marié and Curicuary rivers.

The fibre is obtained from the veins of the sheaths of the young leaves; when the leaf has left it, the sheath curves back over the stem and decomposes, leaving only the fibre which covers the stem. This fibre is dark in colour and of great strength, elasticity and resistance. The finer fibre is used for making cord, the coarser for brooms, mats, mattresses and baskets.

The piassava of the Amazon *Leopoldinia*, which is the finest of all, is used for making clothes brushes. Cord made from this fibre is very resistant to the corrosive action of sea-water. Each tree is capable of yielding about 4 to 6 ½ lbs. of fibre per annum.

The Amazon piassava is much scarcer and much inferior in quality to that of Bahia. In both states the number of piassava palms is diminishing owing to bad harvesting. Thus, whereas, in 1890, 5604 metric tons of piassava were exported from Bahia, in 1900 only 1703 tons were exported.

Practically all the Brazilian piassava is exported from the ports of Bahia and Manaus; in 1914 there were exported from these two ports over 1753 tons, representing a value of 633 368 paper milreis (1).

The principal importing countries up to 1914 were: Great Britain, to whom about 2/3 of the exports went, Germany and Portugal. The exports to other countries are comparatively negligible.

Brazilian piassava already competes with that obtained in Africa from *Attalea junifera*, and largely produced in the British African colonies, especially Sierra Leone. In 1914 this colony exported 999 metric tons, valued at 98 378 milreis.

Besides fibre, *Attalea junifera* also produces a stone fruit, from 8 to 10 cm. in diameter. The pulp is used for feeding pigs; the very hard kernels supply a sort of vegetable ivory and are used for making buttons, etc. In 1914 over 1634 tons of these kernels, valued at 113 609 paper milreis

(1) Paper milreis = 18.48 at par

(Ed).

were exported to Brazil. The only countries which import this product are France, who buys nearly all of it, Germany, Great Britain and Belgium.

These kernels are made to burn with difficulty, but, once alight, give out a great heat, and can replace coal.

On an average the trees produce 500 fruit per annum, and, as an average of 500 kernels go to a ton, $2\frac{1}{2}$ acres with 450 trees would supply 2 tons of fuel per annum. At present these kernels are only used in the Rio de Janeiro district.

817 - **The Castor-Oil Plant in Egypt** (Note presented to the Official Commission of Agricultural Commerce). — MOSSELI, V., in *Bulletin de l'Union des Agriculteurs d'Egypte*, Year 15, No. 118, pp. 1-29, Cairo, January-February 1917.

Although the castor-oil plant has been known in Egypt since very remote times, it is no longer put to any commercial use. This neglect is due to economical considerations. The current prices for the seeds of the plant are very high, but they must be considered as abnormal and unlikely to continue after the war. There is little likelihood that the cultivation of castor-oil will be started again in this country, unless it be on the banks of the irrigation dykes.

Owing to its root system castor-oil cannot be planted near other crops. It might be grown on the canal banks either for its seed or for the breeding of *Attacus Cynthia* (1), as is done in Hindoustan; in any case, preliminary tests are necessary before the chances of success of this new silkworm industry can be determined. For seed production, the castor oil plant needs well-drained, non-saline soil.

The weight of the seeds, their volume and the percentage of kernel and shell, are different in each variety, and for the same variety, according to the district, the season and the harvest. The physical properties of the soil seem to have only a secondary influence on these various factors, but an excess of water or salts in the soil decreases them all to a more or less notable extent, this decrease affecting the kernel and shell of the seed in almost identical proportions. Whereas the weight and volume are greatly affected by an excess of water or salts in the soil, the percentage of kernels and shells is affected to a much smaller extent.

The oil content depends especially on the atmospheric conditions which prevail during the formation and ripening of the seeds; it also varies with the variety, locality, season and harvest. Variations due to the physical properties of the soil are almost imperceptible. It is affected by an excess of water or salts, but to a smaller extent than the weight. In the same variety the richness in oil seems to increase if the plant is moved from the north to the south and decrease if it is moved from the south to the north. A high oil content seems to correspond to a heavy seed: this has, however, not yet been confirmed.

The ash content is much higher in seeds from the more or less salt soil from the north of the Delta (Bararis) than in those of the other districts.

(1) More properly called *Attacus ricini*; in China *A. Cynthia* is bred on the Almond

unined, nevertheless in the Bararis, the difference in ash content in good is and damp or salt soils is relatively insignificant.

The conclusions deducted from these investigations still require definite confirmation, and, by reason of the interest attached to it, the question deserves a closer study. To this end, seeds of a well specified variety should be sown in three districts — the north, centre and south of the country; the seeds from each district should in turn be sown in each of the two series, and the variations in weight and richness observed during several years.

Results of Experiments on the Preparation of Copra, in Java. — SMITA, M. B., in *Terramania*, Year 27, Pt. 9 and 10, pp. 495-501. Batavia, 1916.

The yield in copra of coconuts collected on the coast of Sumatra, both when very ripe and when almost ripe, was studied. It was found that 500 very ripe nuts, weighing 844.35 kg. (1), gave 127.15 kg. of dried copra, whereas 500 almost ripe nuts, weighing 952.86 kg., gave 128.75 kg. of copra. The yield in copra is, therefore, almost equal. This is proved still more clearly by comparing the percentage of copra with the weight of the nuts separated from the fibre. It was then found that ripe fruit gave 23.5 % and almost ripe fruit 23.3 % of copra. There is, thus, no difference in yield obtained by picking very ripe or almost ripe fruit.

Comparisons between nuts picked near the coast and those picked further inland showed no notable difference.

Further the difference in yield of different varieties was studied, and it was found that the "kerambil sirah" variety was much superior in yield of copra and oil than the "kerambil idjau" variety, which is also very common in the island. This is illustrated by the following averages:

	Total weight		Weight in percent. of the weight of the non-decorticated fruit	
	Kerambil idjau	Kerambil sirah	Kerambil idjau	Kerambil sirah
Yield of copra	0.180 kg.	0.230 kg.	18.3 %	24.2 %
Yield of oil	0.097 kg.	0.128 kg.	9.9 %	13.4 %

9 - Seeds of the Madagascar Physic-Nut Tree (*Jatropha Curcas*). — See No. 533 of this Review.

- 820 - Study of the Sucrose Variations in Successive Cane Joints as They attain Maturity with Special Reference to the Death of the Leaves. — VENKATARAMAN, T. S. and KRISHNAMURTI, ROW K., in *The Agricultural Journal of India, Special Indian Science Congress Number 1917*, pp. 117-126, Agricultural Research Institute, Pusa, 1917.

The sucrose value of any sugarcane seedling is ordinarily ascertainable only when the seedling is ripe and is harvested i. e. twenty months from the date of germination. An attempt was made at the Coimbatore Sugarcane Breeding Station to get an earlier indication of the sucrose value of a seedling, analysing the part of the cane which bears only dead leaves under the hypothesis that the death of the leaf corresponded to some definite process or cessation of process in the joint to which the leaf is attached. A series of fortnightly analyses of thick canes, thin canes and seedlings was instituted to test the value of this method of "dead leaf" analysis.

The series yielded a new method of ascertaining the ripeness of any variety or seedling. It was found that :

In a very immature cane the highest sucrose content is found in the lowest section. As the cane advances in maturity this region of the highest sucrose content gradually moves upwards. If different canes of the same variety are analysed on different dates, the highest sucrose contents obtained on these dates are practically identical. A cane left growing in the ground after it has attained maturity shows rapid deterioration at the basal points. The highest sucrose reading obtained by sectional analysis of any particular variety probably represents the highest sucrose content that the variety is capable of containing under the given conditions, and this the writers have called the "sucrose index" of the cane. It is claimed that this is fairly constant for each variety or seedling and will enable a comparison to be made between different seedlings, even when they are immature.

- 821 - Effect of Sulphuric Acid Sprays on Sugar Beet: Experiments carried out at the Sugar Industry Experiment Station, Prague (Bohemia) (1). — ANDRLEK, K. in *Zeitschrift für Zuckerindustrie in Böhmen*, Year 41, Pt. 10, pp. 685-688, Prague, July 1917.

The experiments described, carried out at Ouholičky (Bohemia), were undertaken to ascertain whether the addition of sulphuric acid is capable of replacing in the soil the nutritive elements contained therein in an unassimilable form by transforming them into compounds which can be utilised by plants. The experimental plant chosen was the sugar beet.

During the 1912 experiments the plots were 1 are (2) in area. One received 2 kg. of sulphuric acid at 50° Baumé another a double quantity, and two others served as controls. The acid was diluted in 10 times its volume of water and applied with a hose. One of the untreated plots, and that treated with 2 kg. of sulphuric acid were attacked by insect pests; moreover, they were faulty, and at harvest time the produce was not entirely ripe. On the other plots growth was more vigorous and more regular. The same experiments were repeated in 1913. Germination was best on the plots treated with 4 kg. of sulphuric acid and the plants on it were

(1) Cf. R., 1916, Nov. 196. — (2) 1 are = 119.60 sq. yards.

a brighter green. The numerical results (given in appended tables), though of general value only, seem to prove that sulphuric acid did not increase the crop, but that it had no harmful effect on the sugar content or purity of the juice.

Action of Sulphuric Acid on Sugar Beets.

	Yield per acre		Sugar obtained by digestion in warm water	Composition of juice		
	Roots	Topa.		Saccharose	Polarisation	Quotient of purity
	tons	tons				
<i>1912 Experiments:</i>						
Controls (averages of 2 plots) . .	9.71	18.59	15.8%	19.6%	17.07	87.05
Watering with 2 kg. per are of sulphuric acid	7.84	14.41	15.0	19.0	16.25	85.5
Watering with 4 kg. per are of sulphuric acid	10.91	22.42	15.8	19.5	16.9	86.6
<i>1913 Experiments:</i>						
Controls	13.61	11.50	18.0	21.45	19.57	91.2
Watering with 2 kg. per are of sulphuric acid	13.14	10.27	18.2	21.55	19.82	91.9
Watering with 4 kg. per are of sulphuric acid	12.50	10.11	18.4	21.90	20.10	91.8

2. Experiments in Transplanting Coffee at the Porto Rico Agricultural Experiment Station. — McCLELLAND, T. B., in *Porto Rico Experiment Station Bulletin* No. 22, 12 pp. + 1 plate. Washington, June 29, 1917.

In Porto-Rico, the general practice in transplanting coffee has been to pull, or dig out without any adhering soil, a young tree several feet high with little care as to how many small roots were broken off, and to re-plant with no leaf pruning.

In a previous publication, the Porto-Rico Experiment Station suggested the advisability of selecting seed from vigorous trees and making nurseries for the production of vigorous seedlings.

The object of the Bulletin analysed is to report the results of a trial showing the advantages and disadvantages of different methods of transplanting coffee plants.

Coffee seedlings with only 5 to 6 pairs of leaves, when transplanted with the roots incased in a ball of earth from the nursery, show little difference in early growth and yield as a result of transplanting from those transplanted with roots bare of earth, provided the latter transplanting is properly done.

By leaving the seedling in the nursery 1 year longer, that is to say by transplanting them at the time of the second rainy season after sowing, a more even stand may be obtained, since the plants are thriftier and better able to cope with unfavourable conditions. The fact that it is more eco-

nomical to leave the plants in the nursery than to transplant them makes it also advisable to adopt this method.

When the seedlings are removed from the nursery to the plantation approximately 18 to 20 months after the seed has been planted, a considerably earlier growth and increased yield may be expected to result from transplanting the roots incased in a block of soil, rather than with the roots free of soil. This difference should be considerably greater in average planting than in the experiments when care was taken to avoid breaking and drying out the roots. In the 1st. experiment, the plants removed with a ball of earth measured at the end of the 1st. year 35 per cent. more in height than those transplanted with bare roots; at the end of the 2nd. year they were 23 per cent. higher than the check. Their yield the second year was double that of the check. In a 2nd. test, the increased growth for the 1st. year was nearly 12 per cent. greater, while their yield the 2nd. year was 3 times as great. In the 3rd. experiment, the increase in height was 43 per cent. greater than that of the check at the end of 2 years, while the crop was more than doubled. The writer therefore recommends the following method of handling young coffee seedlings: mature seed selected from trees of desirable types may be planted immediately after pulping, or may be washed free of the mucilaginous coating, and kept in an airy shaded place for a period not longer than 3 or 4 months previous to planting. Excessive drying must be avoided, as this will destroy the viability of the seed.

The seed should not be planted deeply, $\frac{1}{4}$ in. of soil being a sufficient covering. The seeds may be sown in the nursery, or in boxes from which they may be transplanted to the nursery when the cotyledons have hardened. Previous to germination, the soil should not be allowed to dry out. In the nursery, the seedlings should not be less than 8 inches apart. Here they may remain until the 2nd. rainy season after planting.

Too dense shading or an exposure to too full sunlight should be avoided. Numerous small scattered nurseries are preferable to fewer and larger ones, as they greatly facilitate the transportation of the trees at the time of planting.

Where the soil is a heavy clay, it is necessary to transplant the seedlings with their roots incased in a ball of the soil. The plant should be so set that in its permanent location it is no deeper than it was in the nursery, with the root collar just below the surface of the soil. A very common practice, and one which is to be condemned, is that of setting a tree in a depression in which the soil gradually accumulates, burying deeply those roots which should remain near the surface and facilitating the entrance of root fungi.

823 - **The Effect of Some Alkaline Salts Upon the Fire-holding Capacity of Tobacco.** - KRAYBILL, HENRY, R. (Contributions from the Hull Botanical Laboratory), in *The Botanical Gazette*, Vol. LXIV, No. 1, pp. 42-56. Chicago, Illinois, July 1917.

The term, burning qualities of tobacco, expresses many characters of which the chief are: uniformity of combustion — colour of the ash — compactness and cohesion of the ash — and fire-holding capacity; the latter signifies the length of time the leaf continues to burn after having been

fire to. This latter character has been the principal criterion used in determining the burning qualities of tobacco.

The writer rapidly considers the opinions hitherto expressed by various other writers on the subject of the factors influencing the fire-holding capacity. As these opinions are contradictory, the writer, in order to elucidate the question, studied the effects of different salts of potassium, or similar bases, upon the burning qualities of tobacco. He used carbonates, oxalates and citrates of potassium, sodium and lithium, carbonate of rubidium, tartrates of sodium and of potassium, etc. With a few to comparison, he also studied the effect of several alkaline salts upon the combustion of various kinds of paper and of a piece of sugar. In all these cases, the salt solutions used were normal 28.9 per cent. solutions. It has been suggested, that the effect of the different salts upon the colloidal condition of the substance of the tobacco leaf may be related to the fire-holding capacity of the latter. In order to test this point, some leaves were acidified by treatment with 0.5 normal acetic acid, others alkalinised by treatment with a normal 0.2 solution of sodium hydrate. The salt solutions were applied in the form of very fine spray by an atomiser. The leaves, after being sprayed, were placed under a bell-glass, in order to allow the salts to extend over the whole surface; the duration of the combustion being determined for each leaf from 3 pieces, cut respectively from the tip, centre, and base of the leaf. Each determination was repeated on several leaves.

The results obtained indicate that :

- 1) Carbonates of caesium, rubidium and potassium have a marked effect in aiding the fire-holding capacity of tobacco, while on the other hand, carbonates of sodium and lithium have not the same effect. The first salts are given in decreasing order of efficiency.
- 2) Of the oxalates used in the experiments, only potassium oxalate produced any effect. As regards carbonates and oxalates in an alkaline medium, lithium carbonate and oxalate as more efficacious than the same sodium salts in bringing about the precipitation of the colloids, and are also little more efficacious in promoting fire-holding capacity. In the case of the citrates, this relation does not exist. The carbonates of potassium, rubidium and caesium behave in the same manner. It is thus doubtful whether the effect of salts upon the colloid condition of the tobacco leaf is of any importance as regards the burning qualities of the latter.
- 3) Only citrate of potassium promotes the burning qualities. The action of the citrates of sodium and lithium is almost *nil*.
- 4) Of the compounds of potassium, the organic salts of this metal, the carbonate, tripotassic phosphate, bipotassic phosphate and the sulphate increase the fire-holding capacity, while the chloride, the acid sulphate and the monopotassic phosphate have a bad effect upon the burning qualities.
- 5) Carbonate of sodium slightly increases the fire-holding capacity, but all the other sodium salts have no effect, or a harmful one.
- 6) The data obtained do not support the idea that the favourable action of salts of potassium is to be attributed to their reduction.

7) It has been ascertained, that the injurious effects of chlorides are not due to the fact that they melt, as was suggested by BARRR (*Landwirtschaftliche Versuchsstationen*, Vol. 39, pp. 81-104, 1891).

8) It has been proved, that the favourable action of carbonate of potassium is not caused by the alternate liberation and absorption of carbonic acid.

9) The effect of salts in raising the leaf temperature may be of some importance.

10) The problem is most likely a complicated one, and the action of the salts of caesium, potassium and rubidium may be attributable to many factors.

11) It would seem probable, that caesium, potassium and rubidium in the form of certain salts, such as carbonates, sulphates and phosphates have a specific catalytic action in combustion, and that the chlorides have a negative catalytic action. The writer intends to study the progress of the decomposition of several organic substances treated with alkaline salts and subjected to temperatures equal to those reached by a cigar while burning.

Appended to the article is a bibliographical list of 17 publications mentioned in the text.

824 - **Variety Tests of Vegetables Carried Out at the Maryland Agricultural Experiment Station, United States.** — WHEAT, T. H., in *Maryland Agricultural Experiment Station Bulletin* No. 204, pp. 231-262. College Park, M. D., March 1917.

The testing of new varieties as soon as they are put on the market is an important part of the work of the Experiment Station. The Bulletin analysed gives the results obtained in the past 10 years. The following are the varieties which seemed the best, or the most interesting.

ASPARAGUS. — There is little difference in asparagus varieties. Palmetto is a good variety and resistant to rust (*Puccinia Asparagi* D.C.).

BEETS. — All the varieties tried: Early Blood Turnip — Extra Early Egyptian — Early Model — Early Eclipse — Early Bassano — Black Red Ball — Long Blood Red — Detroit Dark Red — are excellent.

LIMA BEANS (*Phaseolus lunatus*). — One of the best climbing varieties is the King of the Garden. Carolina, or Sieva, is a small, very prolific sort; the same may be said of Henderson's Bush and Dreer's Bush. Though Fordhook Improved Bush is a dwarf variety, its pods and beans are as good as those of the large pole beans. It does best on light, well drained soils.

SNAP BEANS. — The best varieties are: Extra Early Valentine Bush very early — Valentine Wax, a little later — Longfellow; gave the largest yield, (25 ft. of row produced 1134 pods weighing 14 lbs. 2 oz.). — Dandel Case Knife — Kentucky — Wonder and Lazy Wife Pole.

GARDEN PEAS. — In general these are divided into the classes of round or wrinkled, dwarf and tall. The round smooth peas are mainly hardy and early. The wrinkled varieties are later and less hardy. In 1914 the following varieties produced the best crops: Carter's Daisy (7 lbs. 4 oz. from 25 ft. of row) — Sensation (7 lbs. 2 oz.) and Juno (7 lbs. 2 oz.).

15, the best crops were obtained from : Marvellous (7 lbs. 8 oz.) — Extra Early Blue Bantam (7 lbs.) — Telephone (5 lbs. 8 oz.) — in every case the row was 25 ft.

The early peas which are most widely planted are Alaska and its strains. American Wonder and Nott's Excelsior are the dwarfest and earliest of the wrinkled varieties. Stratagem and Thos. Laxton are good varieties of a somewhat taller class of wrinkled peas. Telephone is the wrinkled pea most extensively grown by the market gardeners. Champion of England is very late. To keep up as long a succession as possible for picking, the following varieties should be planted *early* : Alaska — Extra Early Blue Bantam and Early Springtime (smooth varieties); while some of the wrinkled kinds to be sown *late* are : Nott's Excelsior — Little Marvel — Thos. Laxton — Stratagem — Telephone — and Champion of England.

MUSK MELONS. — The best varieties are Rockyford — Eden Gem — Buskirk's Gem — Salmon Tint Pollock — Buskirk's Rustproof (the latter very resistant to leaf spot, *Cercospora melonis* Cke., but it is not immune and must be sprayed, like other varieties, with Bordeaux mixture) — Sweet Sir — Knight — Anne Arundel — Baltimore Nutmeg.

CABBAGES. — a) *Early* : The cabbages most used for early planting are the smaller kinds which make a hard head in a short time. The head may be pointed, round, or flat. The first mature the quickest, and are earliest planted. The round and flat types mature a week or two later; it is necessary that early cabbages should mature uniformly, that is to say, they should all be ready for market within two weeks after commencing to cut. The three best varieties of early cabbages are, in descending order of early Jersey Wakefield (pointed head) — Copenhagen Market (flat head) — succession.

b) *Late* : These are generally large varieties, and range in size from 15 lbs. each. The experiments at the Maryland Experiment Station are mainly undertaken with a view to discover disease resistant and uniform heading kinds (see *Bulletin* No. 133 of the *Maryland Agricultural Experiment Station*). Late cabbages are subject to many diseases. The 3 worst of these are : "yellows" (*Fusarium Conglutinatum*); "black rot" (*Pseudomonas camestrus*); and "black-leg" (*Phoma oleracea*). Of all the varieties tried, Volga is the best heading and most resistant variety. It is especially suitable for boiling, but not so good for slaw or sauerkraut. Johnson's Ever-Ready and Late Stonehead are the Volga renamed.

Houser is very resistant, but does not head quite so uniformly as Volga. Autumn Giant is quite resistant and grows large, making good heads.

CHINESE OR PE TSAI CABBAGE. — No. 36054 U. S. Department of Agriculture was the best.

CAULIFLOWER. — The variety Snowball seems most suited to the conditions at the Station.

CELERY. — Golden Self-Blanching is the most extensively grown variety, though less vigorous and more subject to disease, it is easily blanched and has a good appearance. French grown seed is considered the best. Recently introduced variety called Henderson's Easy Blanching is very

vigorous and disease resistant. White Plume has variegated leaves; it is a very good variety. Giant Pascal when well blanched is the tenderest of the varieties grown; it is, however, very subject to rust (*Puccinia bullata* [Pers.] Wint.).

EGG PLANT. — Black Beauty — New York Improved — and Florida High Bush are good varieties.

LETTUCE. — The best varieties of the large, plain or wavy leaved heading types are: Big Boston — Cream Butter and May King. — White Seeded Tennis Ball and Commodore Nutt are good of the dwarfier hard heading varieties of the same type. Giant Crystal Head and New York have fringed tender leaves that make heads — Curled Simpson and Grand Rapids have fringed leaves that do not make solid heads. The curly leaved types of lettuce are rarely attacked by tip-burn.

SUGAR CORN. — The earliest varieties are: Golden Bantam — Gillespie's Early Neck — Adam's Extra Early — resistant to drought; Seymour's Sweet Orange — White Evergreen — Cosmopolitan — Gillespie's Early Neck — Earliest Sheffield — Bloomsdale — New Ideal — Hickman's Extra Early — Holme's Premo — vigorous and little attacked by Smut (*Ustilago Maydis*): Minnesota — Metropolitan — Bountiful — Howling Mob.

RHUBARB. — Of the American stock, Gude's is the best variety, while Daw's Champion is the most distinct English variety tested.

TOMATOES. — Of early varieties "Earliana" occupies the first place, the second early kinds being Bonny Best — Chalk's Jewel — and John Baer; the latter is a cross between the two preceding varieties. Of the late varieties tested at the Station during the three years 1914-1916 those that produced the largest crops were: Rough Reich (7.9 tons per acre) — Shall-cross (6.5 tons per acre) — Kelly Red (6.5 tons per acre) — Greater Baltimore (6.4 tons per acre). Varieties resistant to wilt (*Bacillus Solanacearum* E. F. Smith) have been isolated from Greater Baltimore and Stone.

SWEET POTATOES. — These are divided into 2 classes, sweet potatoes and yams. The former are smooth and regular in appearance with brownish yellow skins, the latter are usually rough with white or red skins; the flesh of the yam is more mealy when properly cooked. The best varieties are: a) *sweet potatoes* — Big Stem Jersey — Yellow Nansemond — Early Golda — Yellow Jersey — Red Jersey — Vineland Bush — b) *yams*: Southern Queen — Pumpkin Yam — Pierson — Nancy Hall — Black Spanish — Bunch Yam.

IRISH POTATOES. — As an early potato, Irish Cobbler is excellent, but produces a small crop if grown as a late variety. Of the late sorts, White McCormock gave the highest yield during the three years 1913-1915, viz. 181.7 bushels per acre of primes and 28.7 bushels per acre of culls. In these tests the varieties are classified as follows in descending order of yield: Empire State — Manistee — Rehoboth — Pat's Choice — Green Mountain — Pat Murphy's Choice — Enormous — Endurance — World Wonder — Northing — Million Dollar — American Giant — Carman No. 3 — Norcross — Peerless Junior — Rural New Yorker — Irish Cobbler.

Plum-Growing at the Maryland Agricultural Experiment Station. — HOLLAND, F. S., in *The Maryland Agricultural Experiment Station, Bulletin No. 207*, pp. 295-326. College Park M. D., May 1917.

The cultivation of plums in Maryland is neither extensive in scope nor intensive in character; this fruit is grown only for home use and the supply of the local market. The following table gives the number of fruit trees bearing age in Maryland in 1910 and their production in 1909:

Apples	No. of trees in 1910	Production in 1909
Apples	1 288 482	1 822 824 bushels
Peaches and nectarines	1 497 724	324 609
Pears	540 583	397 359
Plums and prunes	69 996	13 526
Cherries	82 305	12 315
Quinces	20 436	6 359

At this time, the plum-growing industry is upon the decline in Maryland, on account of the low prices obtained for the product — the cultivation of insuitable varieties in many instances — the ravages of fungous diseases and insect pests. There are, however, only two really serious plum pests, brown, or ripe, rot (*Sclerotinia fructigena* [Pers.] Schroet.) and curio (*Coniothecium nemophar*). All other diseases and insects are readily controlled and yet black knot (*Ploeroglyphia morbosa* [Schw.] Sacc.) and San Jose scale (*Aspidiotus perniciosus*) have been allowed to destroy large numbers of plum trees. Losses ascribed to either should be charged to neglect and not to the industry.

The most widely grown varieties of plum are: Abundance, Shropshire, York, Wild Goose, Red June, Lombard, German Prune, Satsuma, Shipper and Green Gage. A great many other varieties are, however, also cultivated.

The Maryland Agricultural Experiment Station at College Park has tested a number of native, Japanese, and hybrid varieties in order to determine their suitability for growing in the State. Blooming data for the varieties grown at the Station show that the flowering period of the Japanese varieties normally extends over the first half of April; that of the native varieties over the latter half; and that of hybrids over the entire month.

Cross-pollination of plums is necessary in order to be sure of obtaining a good crop. The orchard should be planted with several varieties blooming at the same time. The choice is facilitated by the tables in the Bulletin which give the blooming dates of 70 varieties grown in the Station hands. In the following summary the varieties are grouped according to species and sub-species and those of each group are arranged in the order in which they come into full bloom. The dates represent the time of first bloom for the earliest and the latest and also for the average of all the varieties of the same species.

Prunus domestica: Shipper, April 17.

Prunus insititia: Shropshire, April 21.

P. triflora: Berkman (March 31) — Abundance — Hale — Bur

bank — Occident — Satsuma — Weeping Blood — Engree — Kelsey — Kerr — Georgeson — Chabot — Red June — Ogon — Maru — Delaware (April 14). Average for species, first bloom, April, 1.; full bloom, April 11; last bloom, April 11.

P. americana: Brittlewood, April 22.

P. hortulana: Dunlap (April 17) — Wayland — Golden Beauty — Rose — Cumberland (April 23). Average: first bloom, April 17; full bloom, April 22; last bloom, April 26.

P. hortulana Mineri: Maquoketa (April 19) — Forest Rose — Nebraska — Prairie Flower (April 22). Average: first bloom, April 15; full bloom, April 21; last bloom, April 26.

P. nigra: Cheney (April 19) — Smith Red (April 20). Average: first bloom, April 14; full bloom, April 20; last bloom, April 26.

P. angustifolia varians: Munsen (April 15) — MacCartney — Yellow Transparent — Lone Star (April 20). Average: first bloom, April 11; full bloom, April 18; last bloom, April 23.

P. munsoniana: Newman (April 15) — Whitaker — Wild Goose — Smiley — Cleveland (April 20). Average: first bloom, April 14; full bloom, April 18; last bloom, April 24.

Hybrids: Climax (March 31) — Chalco — Apple — Nona — Kelmey — Dorio — Kelbalan — Wickson — Bartlett — Ragland — Red October — Combination — Kelroba — First — Shiro — Waugh — Yates — Gonzales — America — Six Weeks — Golden — Excelsior — Holland — Marianna — Preserver — Duke — Milton — Goose Dye — Idall — Goose (April 20).

The essentials of success in plum growing are the selection of suitable varieties; the choice of a proper orchard site, good orchard management and right methods of picking, packing and marketing. For Maryland, the writer especially recommends the following varieties: Abundance — America — Berger — Burbank — Chabot — Downing — German Prune — Gonzales — Greengage — Milton — Newman — Red June — Shropshire — Whitaker — Wild Goose.

826—**The Pine Trees of the Rocky Mountain Region.** — SUDWORTH, G. B. (Dendrologist in United States Department of Agriculture Bulletin No. 460 (Contribution from the Forest Service, Professional Paper), pp. 1-46, XXVIII plates, 14 maps. Washington, D. C., May 26, 1917.

A monograph on the dendrology of the different species of pine in (Pinus sp.) that inhabit the Rocky Mountain region. The exact limits of the territory covered by this publication are given in a preceding article of the writers (1). Some 70 species of pines are known in the world; of them grow in the United States, 14 of the latter being found in the Rocky Mountain region. Six of these Rocky Mountain species occur also in the Pacific slope region, and 1 ranges eastward from the Rockies in Canada into the Atlantic Coast country (Pinus Banksiana). The cones of some pi

(1) See B., 1915, No. 1165 and R., January 1917, No. 50.

remain closed for several, or many seasons; those of one American species (*Pinus albicaulis*) never open naturally. This explains how certain species often reproduce themselves after a forest fire.

The pines described are divided into 2 large groups:

WHITE PINES: *Pinus monticola* Douglas, known as Western white pine, must not be confused with the true white pine, *Pinus Strobus*, the wood of which tree it now largely replaces (1). — Limber pine (*Pinus flexilis* (Mills) — white bark pine (*Pinus albicaulis* Engelm.) — Mexican white pine (*Pinus strobiformis* Engelm.) — Mexican piñon (*Pinus cembroides* (Lam.) Mill.), this tree has the heaviest wood of all the Rocky Mountain pines; it is used only for fuel and other domestic purposes; the seeds are edible — Gambel's pine (*Pinus edulis* Engelm.), the seeds of this pine are eaten by the Indians and settlers — Single-leaf pine (*Pinus monophylla* (Lam.) Mill.) the only single-leaved pine of North America; the seeds are also much used for food — Bristle-cone pine (*P. aristata* Engelm.).

YELLOW PINES. Arizona pine (*Pinus arizonica* Engelm.) — Western yellow pine (*P. ponderosa* Lawson) is one of the most majestic of the pines of N. America; in general, the height is from 125-140 ft. with a practically clear trunk of from 40-60 ft., while some trees are said to have attained the height of over 200 ft. It produces one of the most valuable woods of the Rocky Mountain region; the wood is, however, only moderately durable in contact with earth, or when exposed to the weather in an unprotected state — Apache, or Arizona longleaf pine (*Pinus apachea* Lemmon) — Chihuahuan pine (*P. chihuahuana* Engelm.) — Lodgepole pine (*P. contorta* (Lam.) Mill.) — Jack pine (*P. banksiana* Lambert) (2).

— **The Eucalyptus as Fuel in North Africa.** — TRABUT, in *Comptes rendus des Séances de l'Académie d'Agriculture de France*, Vol. 3, No. 28, pp. 834-836. Paris, July 25, 1917.

Certain countries, owing to the difficulty of obtaining coal, have been obliged to employ wood for fuel on a large scale. The cultivation of trees of rapid growth is a question of great interest. The eucalyptus, especially *E. globulus*, are among the almost interesting trees in this connection. Two pounds of dried wood of *E. Globulus* are equal to one pound of briquettes for firing locomotives. It is already held in considerable value on the Algerian and Tunisian railways, which are considering the possibility of its continued employment.

E. Globulus appears to be the best paying species owing to its rapid growth and to the closeness with which it can be planted.

A hectare (2.47 acres) of bare and unutilised marshy ground, such as the Fetzara basin (13 000 hectares) would allow of the planting, at a trifling cost, of 1600 to 2 000 one year-old eucalyptus seedlings. When 6 years old these trees would have a diameter of 20 cms. and a height of 12-15 metres. A first cut could then be made which would give 500 to 1 000 cubic metres.

(1) See B. 1915 No. 719. — (2) See B. 1911, No. 1204 and B. 1915, No. 1168.

(Ed.).

After this felling the trees begin to grow again from the stump and in 6 years give an increased quantity of wood of improved quality. In the conditions described above, a hectare of *E. globulus* is capable of yielding metric tons of dry timber for fuel.

The eucalyptus, which is very hard when dry, is easily cut when green. The branches can be utilised for making briquettes or the leaves distilled for oil, the yield being 1.5 per cent. of the fresh leaves.

LIVE STOCK AND BREEDING.

828 - **Poisoning of Cattle by Ragwort (*Senecio jacobaea* L.), in England.** - *Journal of the Board of Agriculture*, Vol. XXIV, No. 4, pp. 433-436. London, July 1922.

This note has been prepared by the Chief Veterinary Officer of the Board of Agriculture.

In South Africa, Canada and New Zealand much attention has been given to the subject of cattle poisoning by certain species of ragwort. Until the actual cause was discovered, the cases were attributed to a disease which was known under different names (Picton, Winton and Mott disease). It is not generally recognised that the common British ragwort (*Senecio jacobaea* L.) is poisonous to cattle. This probably arises from the fact that poisoning under natural conditions is a slow process, the action of the poison being cumulative. The actively poisonous agent in the plant seems to be one or more alkaloids which it contains.

In a case recently studied in the Laboratory of the Board of Agriculture, the first symptoms of the poisoning appeared in a herd of cattle 10 days after they had begun to eat dry forage containing much ragwort. The time elapsing between the first appearance of definite symptoms and death varied from a few days up to a month. Some of the animals did not show definite symptoms until 12 days or more after the feeding with ragwort had been discontinued.

The animals suffering from poisoning show signs of nervous disturbance in some there may be diarrhoea, but usually there is marked constipation. The principal lesions found are inflammation of the mucous membrane of the bowel; small haemorrhages are present under the above-mentioned membrane and in the pericardium; in acute cases, the liver becomes enlarged.

There is no cure for the disease, and prevention resolves itself into removing the ragwort from the forage, or eradicating it from the pasture. The latter may be done: 1) by pulling up the plant where circumstances permit; 2) by cutting the plants in the flowering season, that is to say, late July or early in August, if the operation can only be done once; the portions of the weed must be gathered up at once and burnt; 3) the ragwort may be cut early in July and again 6 weeks later; in which case there is no need to gather up the cut portions; 4) by grazing infested land with sheep in the winter and early spring.

There is reason to believe that ragwort is most poisonous during the flowering season, from June to early August. The question of whether

ering ragwort is poisonous to sheep is now being investigated at the N.I.'s Laboratory. Having regard to the experience acquired in practice of grazing sheep on ragwort pastures during the winter and early months of the year, it would seem reasonable to assume that the practice is not justified by bad results. This is, however, still an open question.

Paspalum notatum, the Cause of the Disease of Cattle known as "Tembleque" or "Chucho" in the Argentine. — ROSENBUCH, FRANCISCO and LABALA, JOAQUÍN, in *Anales de la Sociedad Rural Argentina*, Year LII, Vol. LI, pp. 245-248, coloured plate. Buenos Aires, May 1917.

In May 1916, the writers, who are members of the Bacteriological Institute of the "Departamento nacional de Higiene", had occasion to remark in the province of Buenos Aires, an hitherto unknown disease of cattle characterised by the animal shivering and falling on the ground (whence the name of "tembleque"), these symptoms being sometimes quickly followed by death. No parasitic micro-organism was found in the blood of affected animals and injections of such blood in cattle and other kinds of animals gave negative results. The authors were thus obliged to state that "tembleque" was produced by poisoning due to some unknown cause.

The truth of this diagnosis has now been shown by examination of the flora of the pastures where the disease has appeared. *Paspalum notatum* Flüg. ("gramillon" or "pasto dulce") is very abundant; it is absolutely harmless when healthy but is poisonous to cattle when attacked by a fungus of undetermined species which forms sclerotia upon the spikes, the sclerotia being of a pinkish colour tending more or less to white, grey or black.

The inflorescences attacked by the fungus are innocuous to horses. As a preventive measure, the writers recommend turning horses out of the fields before cattle are allowed to graze them. If this is not practicable the field should be harrowed as this shakes out the infected seeds, the latter being much more easily detachable than the sound ones. With regard to curative measures, the writers recommend tapping the jugular; subcutaneous injections of eserine and of chloride of pilocarpine; purgatives. DR. JUAN N. MURTHAGH has also observed this disease in the provinces of Buenos Aires and of Santa-Fé. The number of cattle infected was from 10 to 50%.

Experiments in Controlling Ectoparasites on Poultry in the United States (1). — BISHOPP, F. C. and WOOD, H. P., in *Farmer's Bulletin* 801, United States Department of Agriculture, 26 pp. 14 fig. Washington, May 1917.

A description of the following external parasites on poultry and the methods of control adopted against them.

1. MITES. "Common Chicken Mite" (*Dermanyssus gallinae* De Geer) — "Scaly Leg Mite" (*Cnemidocoptes mutans* Robin). — "Depluming Mite" (*Cnemidocoptes gallinae* Railliet) — *Laminosioptes cysticola* Vizioli — *Cyrtolobus nudus* Vizioli — *Rivoltasia bifurcata* Rivolta — *Freyana chanayi*

(1) See also B. 1915, No. 1313.

Trouessart (recently found by the writers as an external parasite of the turkey in Texas and Louisiana) — *Megninia cubitalis* Megnin.

II LICE. — More than 40 species of lice are found on the various domestic fowls.

LICE ON CHICKENS: "Head Louse of Chickens" (*Lipeurus heterographus* Nitzsch) — "Body Louse of Chickens" (*Menopon biserialatum* Piaget) — "Shank Louse" (*Menopon pallidum* Nitzsch) — "Wing Louse" (*Lipeurus variabilis* Nitzsch) — "Fluff Louse" (*Goniocotes hologaster* Nitzsch) — "Large Head Louse" (*Goniocotes abdominalis* (Piaget) — "Brown Chicken Louse" (*Goniodes dissimilis* Nitzsch), which has not before been reported to occur in America, but which the writers have found in Texas and Florida.

LICE ON TURKEYS: *Menopon biserialatum* — *M. pallidum* — "Large Turkey Louse" (*Goniodes styliifer* Nitzsch) "Slender Turkey Louse".

LICE ON DUCKS: *Docophorus icterodes* Nitzsch (one of its varieties attacks geese) — *Lipeurus temporalis* Nitzsch.

LICE ON PIGEONS: "Slender Pigeon Louse" (*Lipeurus baculus* Nitzsch) — "Broad Pigeon Louse" (*Goniocotes compar* Nitzsch).

The writers advise starting the campaign against these parasites during the late summer or early autumn, for, at this time of year, weather conditions are usually favourable for dipping, and much of the superfluous stock has been disposed of, so there are fewer birds to treat. If the autumn treatment has been neglected, it is imperative that the flock be cleaned of lice before the brooding time in the spring. The writers have tested a number of the new materials most generally advocated for lice destruction, and several new compounds which it was thought might be effective.

The writers state that the common chicken mite can be destroyed by 2 or 3 treatments of the whole fowl-house (roosts, nests, walls and roof) at intervals of one month. The fowl-house should be thoroughly and carefully sprayed with crude petroleum, or with one of the liquids used for the preservation of posts and other timbers set in the ground and consisting of anthracene oil with zinc chloride added. Crude carbolic acid is quite effective, but does not last long. The best cure for scaly leg is to dip the fowl's legs into crude petroleum; if necessary, the treatment may be repeated in a month's time.

For lice destruction, no remedy has been found so satisfactory as sodium fluoride (commercial 90-98 % NaF). Its action is comparatively slow, but, as the material persists, the adult and young lice are all destroyed. One application is sufficient. Sodium fluoride may be applied in two forms, as a dust and as a dip. In the first case, the best method consists in placing pinches of the powder among the feathers next to the skin, and as all species of lice do not migrate freely from one part of the bird to another, it is necessary to place small amounts of the insecticide on different parts of the infested fowl: one pinch on the head, one on the neck, two on the back, one on the breast, one below the vent, one on the tail, one on either thigh, and one scattered on the underside of each wing when spread. The sodium fluoride can also be applied by means of an ordinary can with holes punched in the bottom and provided with a close-fitting lid on the other end. Larger quantities

ies of the insecticide are, however, used in this way; further the dust gets in the air, thus causing irritation of the throat and nose of the operator. The amount of sodium fluoride used may, however, be reduced by adding four parts of road dust or flour to each part of the chemical, while the operator can be protected by wearing dust guards over the nose, or by simply keeping pieces of wet cloth over the nose and mouth.

The writers are of opinion that the application of the insecticide by means of a dusting machine, or revolving barrel, might bruise the fowls and would be irritating to the air passages of the birds.

The dipping method is easier and quicker. Three-fourths to 1 ounce commercial, or $\frac{3}{8}$ ounce of chemically pure sodium fluoride is added to each gallon of water. The water should be tepid and the bath filled to within 6 or 8 inches of the top. In dipping the fowls, it is best to hold the wings over the back with the left hand and quickly submerge the fowl in the solution, leaving the head above while the feathers are thoroughly ruffled with the other hand, so as to allow the solution to penetrate to the skin of the bird. The head is then shaken once or twice. The total time required for each fowl is from 30 to 45 seconds. The approximate cost of treating 100 fowls by the pinch method is \$1.25 while the dipping method reduces the cost to \$0.75. These estimates include labour and cost of material.

Dusting with flowers of sulphur has been found efficacious, but about 4 days are required for the fowls to be quite freed from living lice.

The writers have also found that dipping fowls in a soap solution (2 oz. per gall. of water) will destroy all lice present, but a second dipping 7 days later is necessary in order to destroy the lice that have hatched out in the interval. As the soap solution causes a complete wetting of the feathers, it should only be used during favourable weather, as otherwise there is danger of producing colds.

Amongst other remedies used for the control of fowl lice, a mixture of de carbolic acid, gasoline and plaster of Paris may be mentioned: it, however, must be applied several times. Mercurial ointment is effective in case of *Menopon biserialatum*, but is of little use in the control of *Lipeurus pectoratus* and *L. variabilis*, the treatment having to be repeated several times in the case of the latter, which makes it very expensive. Compounds with a pyrethrum base do not completely destroy the lice. For head lice in young chickens, carbolated petrolatum applied in small quantities has been found quite satisfactory. Medicated nest eggs said to control body lice are on the market. For the most part, these consist largely of naphthalene, and though they destroy the lice, are markedly injurious to the hen's eggs as well as to the bird; and if they are allowed to remain for a considerable length of time beneath a hen, she may die as a result.

831 - Experiments to find a Basal Ration for the most Economical Feeding of the Cattle under Northwestern Conditions in the United States. — ELLINGTON, E. F., University of Idaho Agricultural Experiment Station, Annual Report Bulletin No. 50, 16-18. Moscow, Idaho, December 1916.

The experiments undertaken by the Department of Dairy Husbandry of the Idaho Experiment Station to establish a basal ration for dairy cattle under northwestern conditions have been completed.

It has been found that the following ration can be adapted to the high producing cow or to the low-producing cow and, moreover, may be adapted to animals of different weights: *Alfalfa hay, one part; corn silage, 4 parts; grain (consisting of barley, 4 parts; bran, 2 parts; linseed oil meal, 1 part), 1 part.*

To show how closely this ration conforms to the standards established by ARMSBY the following data are given:

900-lb. Cow, Giving 20 lbs. Milk, Testing 4 per cent.		
	Digestible protein	Energy value (calories)
For maintenance	0.46	3,790
To produce 20 lbs. milk	1.00	6,000
	1.46	11,790
Alfalfa hay 7 lbs., silage 28 lbs., and grain 7 lbs. gives lbs.	1.45	11,980
900-lb. Cow, Giving 40 lbs. Milk, Testing 4 per cent.		
	Digestible protein	Energy value (calories)
For maintenance and milk production	2.46	17,790
Alfalfa Hay 10 lbs., silage 40 lbs., grain 10 lbs., gives lbs.	2.45	17,780
1300-lb. Cow, Giving 20 lbs. Milk, Testing 4 per cent.		
	Digestible protein	Energy value (calories)
For maintenance and milk production	1.65	13,790
Alfalfa hay 8 lbs., silage 32 lbs., grain 8 lbs., gives lbs.	1.80	13,890
1300 lb. Cow, Giving 40 lbs. Milk, Testing 4 per cent.		
	Digestible protein	Energy value (calories)
For maintenance and milk production	2.65	19,790
Alfalfa hay 11 lbs., silage 44 lbs., grain 11 lbs., gives lbs.	2.60	19,840

These rations correspond very closely to the rough rule followed by many dairymen, in feeding one pound of grain daily for every pound of butter fat that the animal produces weekly. The complete set of data secured in these experiments will be published in a "Dairy Farm Management Bulletin of the Idaho Experiment Station.

The Mechanical Milker in Dairy-Herd Management in Idaho.—ELLMORON, E. V., in *University of Idaho Agricultural Experiment Station, Annual Report Bulletin No. 92*, pp. 16-18, Moscow, Idaho, December 1916.

The Department of Dairy Husbandry of the Idaho Experiment Station continued during the past year the dairy herd management investigations. A considerable portion of the time was spent with the milking machine installed by the Sharples Company for use on the College herd. It was compiled to show the economy of milk production and the effect on the health of the herd. Attention is being given to the control of the bacterial content of the milk. It is observed that there was no decrease in milk production during the first eight months in the lactation period of the individual cows as compared with similar preceding lactation periods of the same cows. It was also observed that with the same amount of labour necessary for handling the University herd when milking by hand, the herd could be milked three times a day with a resulting average increase in milk flow of 22 %. This procedure is probably not practical for the farmer who is milking cows as a side line, but for the man who devotes his entire life to dairying and who is supplying milk for city markets or cheese factories, this is an important factor in the management of the dairy herd. The effect of the mechanical milker on hard-milking cows is worthy of note. Very frequently cows that are capable of high production are not given the attention they deserve because of difficulty experienced in drawing the milk. As has been noted in the case of one pure-bred Holstein cow in the University herd, Philidea Young De Kol, that with the mechanical milker in 1916, during eight months 11 795 pounds of milk containing 360 pounds of butter were produced. In 1915 during a similar period with hand milking, 9 155 pounds of milk with a fat content of 274 pounds were produced and in 1914 for a similar period with hand milking, 8 500 pounds of milk with a fat content of 336 pounds were produced. Machine milking with this class of cattle seems to increase the length of the lactation period as the average hand milker has a tendency to dry up the cow that he finds difficult to milk.

Close inspection was given each individual animal by the Department of Veterinary Medicine to determine the effect of mechanical milking on the udders. So far no ill effects have been noted.

Special precautions were taken to keep the machine in perfect repair all times. The results obtained so far, however, do not warrant an unqualified endorsement of the mechanical milker.

The observations should extend over two consecutive lactation periods.

A Study of Leading Breeds of Sheep with Special Reference to Production Factors in Idaho.—ELLMORON, E. J. and HICKMANN, C. W., in *University of Idaho Agricultural Experiment Station Annual Report, Bulletin No. 92*, pp. 4-8, Moscow, Idaho, December 1916.

During the past year the Idaho Experiment Station has conducted, as in former years, the work in sheep breeding and management. Comparisons were made of the Southdown, Shropshire, Hampshire, Cotswold and Abouillet breeds with respect to the average weight of the ewe, weight

of fleece, economy of maintenance, weight of lambs at birth, lambing percentage and daily gain of lambs for the first three months after birth. At present there are available records as follows: On weight of fleece, five years on weight of ewes, three years; on economy of maintenance, three years on weight of lambs at birth, three years; on lambing percentage, five years or daily gain of lambs, three years. It is interesting to note at this time the relative economy of maintenance of the Southdowns and Rambouillet the prolificacy of Hampshire ewes and size of their lambs at birth, and the relatively rapid gains of the Hampshire lambs. In addition to the work of preceding years, there were obtained this year the milk yield of ewes of different breeds and data on its composition for, as stated above, there appear to be pronounced differences between lambs of different breeds in rate of growth. A study of tabulated results on the milk yield of the ewes of different breeds and its composition thus far fails to give an adequate explanation for differences in the growth of lambs. This feature of the work will be continued during this year and an additional breed, the Lincoln, will be introduced into the work for the first time. As soon as possible, measurement work will be started to determine rates of growth of the lambs of the various breeds. In connection with the flock-maintenance features of the work, a test will be made during the coming year of peas and oat silage.

A summarised statement of results secured up to the present time in this line of investigation appears in the following table I.

TABLE I. — *Comparative Breed-Management Work.*
Annual records on 35 to 40 ewes of five well-known sheep-breeds.

Breed	Wt. of fleece at 5 years	Rank based on economy of maintenance 1914-15 1915-16	Birth weight of lamb (3 year average) lbs.	Lambing % (3 year average)	Daily gain lambs for 3 months (3 years average) lbs.	Aver. daily milk yield in lbs. (1 year)	Butter fat % milk	Iron
Rambouillet	14.1	1	8.3	147	0.45	2.32	8.82	14
Hampshire	7.8	3	9.4	173	0.61	2.38	6.64	10
Shropshire	11.2	5	8.2	154	0.49	1.65	0.02	14
Southdown	7.3	2	7.1	116	0.39	1.22	8.60	14
Cotswold	15.1	4	7.0	142	0.45	2.46	8.62	14

834 - **Lamb Feeding Experiments (1) in Nebraska.** — GRAMICH, H. J., in *The United States of Nebraska, Bulletin of the Agricultural Experiment Station No. 153*, pp. 1-20. Lincoln, Neb., October 1916.

During recent years much interest has developed in the fattening of lambs on Nebraska farms. In the past the feeding has been done mostly

(1) As regards lamb feeding in U.S.A. see *R.*, 1917, January, No. 65 and May, No.

speculators, who have owned or rented yards at convenient points and shipped in lambs by the train load direct from the western ranches. The e-car feeder who fattens the lambs upon his farm, thereby utilizing much cheaper roughage, has now substituted the speculator.

The purpose of these experiments was to secure experimental data regarding the comparative values of corn and alfalfa hay fed in various forms with and without corn silage.

They compared a ration containing good alfalfa hay for roughage with one containing a poor grade of hay, likewise a ration of corn and good alfalfa with one of the same feeds plus corn silage. A ration of shelled corn and alfalfa hay was compared with one in which both the hay and corn were ground. A ration of ground corn and ground alfalfa was compared with one of the same feeds with corn silage added.

The principal results of the feeding experiments described and discussed in this Bulletin, which contains 12 tables of numerical data, are summarized as follows:

- 1) The addition of corn silage to a ration of shelled corn and alfalfa increased the daily gain 0.005 lb. per lamb and increased the cost of producing 100 lbs. gain 4 cents, but did not affect the net profit per lamb.
- 2) With shelled corn at 60 cents per bushel and alfalfa hay at \$10 per ton, lambs on a heavy feed of shelled corn (approximately 1.5 lbs.) and 1 lb. of alfalfa made gains at a cost of \$5.11 per 100 lbs.
- 3) Lambs on ground corn and ground alfalfa consumed 0.126 lb. more corn and 0.093 less alfalfa daily than lambs on shelled corn and whole alfalfa hay. Lambs on ground corn and ground alfalfa made daily gains of 371 lb. at a cost of \$6.12 per 100 lbs. while those on shelled corn and alfalfa hay made daily gains of 0.393 lb. at a cost of \$5.11 per 100 lbs. Grinding corn and alfalfa and feeding the two mixed together did not produce sufficient added gain to offset the labour cost of grinding.
- 4) Good alfalfa was worth double the value of the poor alfalfa. Lambs on good alfalfa and shelled corn gained 0.035 lb. more per head daily than at a cost of 17 cents per 100 lbs. less than lambs on poor alfalfa and shelled corn. Lambs fed good alfalfa consumed more roughage than those fed hay of poor quality.
- 5) The addition of 0.726 lb. corn silage daily to a ration of ground corn and ground alfalfa did not increase the daily gain, but did reduce the cost of 100 lbs. gain by 31 cents.
- 6) A ration of shelled corn, alfalfa, and silage produced 100 lbs. gain at a cost of \$5.15, whereas a ration of ground corn, ground alfalfa and silage produced 100 lbs. gain at a cost of \$5.81, thus indicating that the whole hay and hay in conjunction with silage was the more economical of the two rations.
- 7) Valuing corn at 60 cents per bushel, good alfalfa at \$8 per ton, and poor alfalfa at \$4 per ton in this experiment, 100 pounds gain on a ration of corn and good alfalfa cost \$4.88, and on corn and poor alfalfa \$4.90.

835 - Economical Pig Feeding; Experiments made in the United Kingdom. — *The Journal of the Board of Agriculture*, Vol. XXIV, No. 4, pp. 436-439. London, July 1917.

Given the high price of foods which, under normal conditions, are also used for stock feeding, but which at the present juncture have to be reserved for human consumption, the problem arises of finding substitutes for the usual pig feeds.

One of the first solutions that presents itself is to turn the animals out to grass, either in fields (of clover, lucerne, or mixed pasturage) or in orchards and woods. During the winter months, grass would be replaced by hay. Green food does not suffice to fatten the animals, but it keeps them in good health. Putting pigs on pasture has the following advantages:

1) A great saving in food suitable for human consumption; 2) sows kept on pasture are more prolific and much more vigorous than those kept in a sty; 3) the young pigs reared in the open are larger and stronger than those born and bred in the sty; 4) the pasture is improved by the presence of the pigs, provided that too many animals are not turned out; if the field is one of lucerne, it is necessary to be able to cut 2 or 3 crops per year; 5) when the pigs graze on wooded land, an appreciable profit is made from food which otherwise is often wasted.

The accompanying Table, which is chiefly based upon the practical experiments of HANSSON, is very useful as giving a choice of complementary food stuffs; those that are marked with an asterisk have been used in the given quantities in the pig feeding experiments carried out by the Department of Agriculture and Technical Instruction for Ireland.

Amounts in lbs. of Feeds Equivalent to 20 lbs. of Barley.

	lbs.		lbs.
Wheat	20	Butter milk	120
Oats	24	Whey	240
*Maize	19	Mangolds	15
Peas	20	Carrots	160
Haricot beans	20	Swedes	200
Peanut cake	16	Turnips	150
Coco cake	18	*Potatoes	80
Palm-nut cake	20	Clover hay	11
Wheat bran	24	Lucerne hay	50
Gluten feed	19	Green clover	140
Dried brewer's yeast	16	Green lucerne	150
Dried brewer's grains	26	Meadow grass	120
Malt dust	26	Silage (oats and vetch)	200
Separated milk	120		

836 - Pork Production Experiments on Field Peas in Idaho. — **IDDINGS, E. J.** and **HICKMAN, C. W.**, in *University of Idaho Agricultural Experiment Station Annual Report Bulletin No 92*, pp. 6-8. Moscow, Idaho, December 1916.

Experiments conducted during the summer of 1916 at the Idaho Experiment Station showed again that the "hogging off" of field peas is a practical and economical method of harvesting the crop and feeding the

hogs. The summarized results of the experiments are indicated in the following Table:

Lot	Area in acres	No. of pigs per lot	No. of days on test	Initial live weight lbs. (Aug. 16)	Final weight lbs.	Gain in lbs.	Average daily gain lbs.	Gain per acre lbs.	Value of pork	
									per acre hogs 8 c.	per acre hogs 9 c.
									\$	\$
1	0.82	14	28	1 246.5	1 700.0	453.5	1.16	553	44.24	49.77
2	0.84	26	21	2 123.5	2 913.5	790.0	1.45	940	54.44	63.84
3	0.70	16	21	2 010.0	2 452.0	442.0	1.32	631	50.48	56.79
4	1.52	18	35	2 875.0	3 560.0	685.0	1.09	450	36.00	40.50

The pigs in lot 2 were fed, in addition to the peas, rolled barley at the rate of two pounds per 100 pounds live weight, or a total of 1162 pounds. The barley cost \$ 30 per ton. The value of the amount fed was deducted in determining returns per acre from the peas.

It is pointed out that the hogs did the harvesting, thus reducing the labour of harvesting and feeding, and that the work left the land in excellent condition for succeeding crops.

37 - **Feeding Experiments to determine the Relative Efficiency of Vegetable and Animal Protein for Egg Production.** — **FREN, MOORE,** in *University of Idaho, Agricultural Experiment Station, Annual Report, Bulletin No. 92*, pp. 28-30. Moscow, Idaho, December 1916.

The relative value of vegetable and animal protein in the ration of laying hens is a subject that is the cause of much discussion among poultry men. Some experimental work has been done, but the question is still an open one. As a means of securing further information the following experiment was planned and started on November 1, 1915, by the Department of Poultry Husbandry of the Idaho Experiment Station.

Four pens of twenty-five fowls each were fed with the following rations:

Pen I		Pen II	
Grain	Mash	Grain	Mash
10 parts peas	3 parts bran	6 parts corn	2 parts bran
14 parts wheat	3 parts shorts	10 parts wheat	1 part shorts
6 parts corn	1 part corn meal		1 part corn meal
	1 part wheat meal		1 part wheat meal
	1 part pea meal		3 parts beef scrap
	6 parts oil meal		1 per cent charcoal
	1 per cent charcoal		
Nutritive ratio 1:4.2		Nutritive ratio 1:4.2	

Pen III			Pen IV		
1 part peas	1 part bran		6 parts corn	2 parts bran	
5 parts corn	1 part shorts		10 parts wheat	2 $\frac{1}{8}$ parts shorts	
10 parts wheat	1 part corn meal			1 part corn meal	
	1 part wheat meal			1 part wheat meal	
	1 part pea meal			1 $\frac{1}{8}$ parts beef scrap	
	3 parts oil meal			1 per cent charcoal	
	1 per cent charcoal				
Nutritive ratio 1:5.5			Nutritive ratio 1:5.5		

The grain was fed in deep litter at the rate of eight quarts a day per one hundred hens, and the mash in open hoppers. The rations were supplemented with green food, grit, shell and bone. In the calculation of nutritive ratios, Idaho analytical data on wheat, bran, and shorts have been used. All other analytical data and digestion coefficients have been taken from Henry's Feeds and Feeding. The fowls were all trap-nested and the number and weight of each were recorded. Moreover, the fowls were weighed at the beginning of the experiment, on May 1, and again on October 31, 1916, and individual weights recorded. The results of the first year are summarised in the following table giving the weights of eggs.

Pen	Per cent under 2 oz.	Per cent 2 oz.	Per cent over 2 oz.
I	46.5	52.7	0.8
II	15.2	72.7	12.1
III	41.9	56.3	1.8
IV	17.5	79.7	2.8

Pen No. II produced 55.8 per cent. more eggs than pen No. I, 51.1 per cent. more eggs than pen No. III, and 35.2 per cent. more eggs than pen No. IV.

The condition of health and gain in flesh show about the same percentage as that of egg production and weight of eggs. The difference in production between pens I and III and pens II and IV indicates that animal protein is essential for heavy egg production. In the ration of pen No. II the beef scrap constitutes 37.5 per cent. of the mash; in that of pen No. IV it constitutes 18.75 per cent. of the mash. The fact that pen No. II produced 35.2 per cent. more eggs than pen No. IV suggested the advisability of increasing the pen by one whose mash would contain an intermediate percentage (28 %) of beef scrap. This experiment with white Leghorn pullets is planned to extend over a period of at least three years.

838 - **Goose Raising in the United States.** — LAMON, H. M. and LEE, A. R., in *U. S. Department of Agriculture, Farmer's Bulletin* 767, pp. 1-6. Washington D. C., February 1917.

Geese are raised successfully in all parts of the United States but are most abundant in the South and in the Middle West. According to the

status of 1910, Kentucky, Tennessee, Missouri and Arkansas contained about 400 000 geese each. The total number of geese declined, however, about 22 per cent. from 1900 to 1910, due largely to the lack of cheap pasture land for grazing, and perhaps partly to the limited demand for goose feathers and goose flesh.

Six breeds of geese have been admitted to the American Standard of Perfection, namely, Toulouse Embden, Chinese, African, Wild or Canada, and Egyptian. In addition to the standard breeds there is the so-called Monel goose, which is a hybrid made by crossing one of these varieties, or the common goose, with wild goose. The common goose found on many farms contains more or less blood of some of the standard breeds and of the wild goose, and is usually considerably smaller than the Toulouse or the Embden. The Toulouse, Embden, Chinese, and African are easily the most popular breeds of geese in the United States, the first two greatly leading the other breeds. An inquiry made in all parts of the country, where geese are commonly raised, by sending a question schedule to the breeders, gave the following results:

Reports from the South. Small common geese were kept very largely in the Southern States, while only a few breeders kept pure-bred geese, of which the Toulouse, Embden, Chinese, African, and Canada were the most popular in this order. Almost all these breeders picked feathers from the live geese once or several times during the year, some farmers picking the feathers as often as once in six weeks. Many reported keeping the geese largely for the production of feathers and did not consider them profitable as market poultry. The averages for these Southern States showed that the gander weighed 11.2 pounds, the goose 10.7 pounds, and the young goose 8.8 pounds. The geese produced 1.15 pounds of feathers which were valued at 54 cents a pound. An average yield of 16.3 eggs was obtained, of which about two-thirds were hatched under geese and the rest under hens. The breeding stock were mated either in pairs or in trios of one gander with two geese, with an average mating of two males to three females. Three-fourths of the geese were marketed alive at an average price of 76 cents, giving a profit of 49 cents. The selling price and the profit reported by farmers who produced geese only or largely for sale as breeding stock were considerably greater than those reported for market stock.

Reports from the North and West. Pure-bred geese were kept very largely in the Northern, Central and Pacific Coast States, as shown by the reports, although some common geese were reported from most of them. The Toulouse and Embden were by far the most popular breeds. Less than half of the breeders reported that they picked feathers from the live geese. Most breeders picked the geese only once or twice and then only during warm weather. In the average for these states, the gander weighed 17.7, the goose 15.2 and the young goose 13.2 pounds. The geese produced an average of 11 pounds of feathers valued at 69 cents a pound. The average egg production was 26.7 of which slightly more than half were hatched under hens. Three-fifths of the geese were marketed alive and brought an average price of \$1.82 and a profit at \$1.16 each.

839 - On the Factors Governing the Sex of the Eggs of the Honey-bee. — MONTGOMERY THALER, OTTO, in *Bulletin de la Société romande d'Apiculture*, Year 14, No. 2, pp. 35-39, Lausanne, 1917.

The writer remarks the curious coincidence by which two workers, M. BOURGEOIS and Prof. GÖLDI of the University of Berne, by entirely different routes, should have reached the same conclusions with regard to the sex of the eggs of the bee.

Since the researches of DIERZON, that is to say, since the middle of the 19th. century, we know that unfertilised eggs give rise to males and fertilised eggs to females (queens and workers). Several theories have been made as to the manner in which the eggs are fertilised. The one most in favour up to the present is that which states that the queen can open or shut the seminal vesicle containing the sperm and thus fertilise the egg passing along the oviduct at will. Another theory supposes a mechanical action, depending upon the position the queen adopts in laying an egg in a male or worker cell: the latter, being narrower than the others would exercise pressure upon the abdomen of the queen, thus causing fertilisation of the egg. The latest theory, that of DIEKEL, claims that the queen only lays fertilised eggs: it is the workers themselves who determine what the sex is to be by means of glandular secretion; thus, the eggs laid in the drone cells would be treated with a "male secretion" and the eggs laid in the worker cells with a "female secretion".

According to this theory, however, there would be 2 kinds of males: those from eggs laid by an unfertilised queen (owing to a unsuccessful nuptial flight or inability of the queen to emerge) and those from fertilised eggs treated with the male secretion of the workers. But such a thing has never been observed; besides, microscopic examination has shown that the sperm plays no part whatever in the development of the males, which tends to establish the fact that, in a normal colony, the drones are derived from unfertilised eggs.

According to BOURGEOIS, "monopoly of sex belongs exclusively to the young nurse bees and not to the queen". The queen only lays fertilised eggs; the workers, if they require males, act upon a fertilised egg (female) by some unknown means in such a way as to suppress a sexual particle, thus "defertilising" it.

GÖLDI, during a long stay in the tropics, has observed the development and mode of life of social insects.

His conclusions are as follows: "In view of what I have been able to observe among insects, especially ants, I am induced to believe that what occurs in the hive must correspond with the laws formally observed in other insects. And I am inclined to think as follows: the whole of the egg laid by the fertilised queen are provided with seminal matter. A seminal filament penetrates the egg which is to give birth to a female, whereas in the case of the egg which is to produce a male the workers prevent the filament from entering. This operation would be effected in the following way: the micropyle (through which the filament would penetrate) is closed by the workers, or else, by means of a special secretion, they kill the seminal thread".

As will be seen, the sum-total of these views is the same as that reached by BOURGEOIS. The writer remarks that, as according to this interesting theory, the workers must enter the male cell every time an egg is laid therein, it would be interesting to confirm experimentally whether this actually occurs in practice.

FARM ENGINEERING.

o - **The Benedetti Double Brabant Motorplough.** — DESSAISIAUX, R., in *Journal d'Agriculture pratique*, Year 81, No. 8, p. 145, fig. 2. Paris, April 19, 1917.

Description of a small double-brabant motorplough, built by M. Benedetti, at Grambois (Vaucluse), France.

The plough is intended for use on medium size farms, for the cultivation of drilled crops, vines or shrubs planted in lines, also for ploughing, etc.



The BENEDETTI Double Brabant Motorplough.

As shown in the figure, the chassis is carried on two driving-wheels, on whose tyres land-grips can be fixed for field work. In front are the fan-cooled radiator, the 2 cylinder, 10-14 H.P. engine under the hood, and the tank fixed to the mud-guard. Behind, the chassis is attached to the turning beam of the 3 furrow double brabant plough, the end of which is supported by a large furrow-wheel, near which is the handle controlling the winging movement. The coupling is by a springlock movement; vertical adjustments are made by the usual system on double-brabant ploughs. A large lever controls the various movements.

The distance between the wheels can be modified according to requirements, so that the land-wheel always runs in the furrow opened on the previous turn. The total weight is 1540 lbs., the machine being able to turn in a circle of 3-foot radius. The present price is 6 800 francs.

841 - **Mechanical Methods of Cultivation of Vineyards.** — RINGELMAN, MAX, in *Bulletin de la Société d'Encouragement pour l'Industrie Nationale*, Vol. 127, No. 3, pp. 599-602, Paris, May-June, 1917.

French vineyards occupy about 1 600 000 hectares (1) of which 640 000 hectares (not including those in Algeria) are cultivated with the aid of draught animals, particularly horses and mules. Before the war, the annual cost of these animals on some farms was from 800 to 1200 fr.

One can reckon that it requires 1 horse per 6 hectares of vines in an average-sized vineyard or per 8 hectares in a large one. In this latter case one must allow for a supplementary animal per 20 to 24 hectares of vines.

Several years before the war, wine-growers were demanding mechanical methods of cultivation capable of doing such work as ploughing to a depth of from 0.10 metre to 0.15 m.; scarifying to a depth of 0.05 m. and of being utilised also for various kinds of work, such as sulphating, dusting, carting, etc. The market for these machines should encourage inventors and makers to work out the best conditions for the application of mechanical methods in a given number of vineyards, as it would be wrong to attempt to construct a single type for all kinds of work.

In order to show the importance mechanical methods of vine cultivation are capable of attaining in the near future, it is sufficient to remember that :

3 departments possess vineyards with an area of over		100 000 hectares
4	" " " " " " " 50 to	70 000 "
13	" " " " " " " 25 to	50 000 "
6	" " " " " " " 20 to	25 000 "

Undoubtedly, not all of these areas mean the employment of mechanical cultivators owing to the method of plantation, length of rows, width of furrows, slopes steeper than 5 %. With the application of mechanical cultivation one can foresee the suppression of ploughing and the use of the cultivator instead (2)

During the last 10 years, excellent results have been obtained with superficial cultivation applied to a vineyard of 70 hectares of the Var, on very clayey soil of low fertility, stony in parts and liable to drought. With this method (3), the two ploughings are suppressed and replaced by 5 or 6 scarifyings. In 1916, the crop gave a little over 100 hl. of wine per hectare.

Thus, instead of 6 to 8 day's work required for the 2 ploughings of 1

(1) 1 hectare = 2.4711 acres. (2) Attention has been devoted to this method of cultivation for some time past. Experiments have been made in Alsace, at the National School of Montpellier, in the South, Algeria, etc. (Ed.)

(3) See B. 1914, No. 640 and R. July 1917, No. 640. (Ed.)

are, all that is required is 5 to 6 days of scarifying spread over a much longer period.

In the Var, a Pilter hoe, covering a width of 1.50 metres, drawn by a heavy tractor, scarified an hectare of vines in from 5 to 5 1/2 hours. Other experiments with tractors are also recorded.

In view of the lack of hands, draught animals, and of the increase in the cost of feeds and upkeep for these animals, the very existence of vineyards is threatened and it is easy to guess the situation might be worsened by the advent of another nature also.

There is, therefore, every interest in hastening the solution of the problems pertaining to mechanical cultivation of vineyards of which the main points might be summarised as follows:

- 1) The over-all width of the apparatus must not exceed 1 metre;
- 2) The apparatus, with plough or cultivator, must be able to return to the same interline, or in one of the neighbouring interlines, while turning an headland which must not exceed 3 metres.

This programme is not exhaustive and encouragement should be given to constructors of apparatus for the mechanical cultivation of vines on slopes and planted at close intervals.

Attention should also be directed to training professional mechanics to act as instructors to drivers of mechanical cultivators.

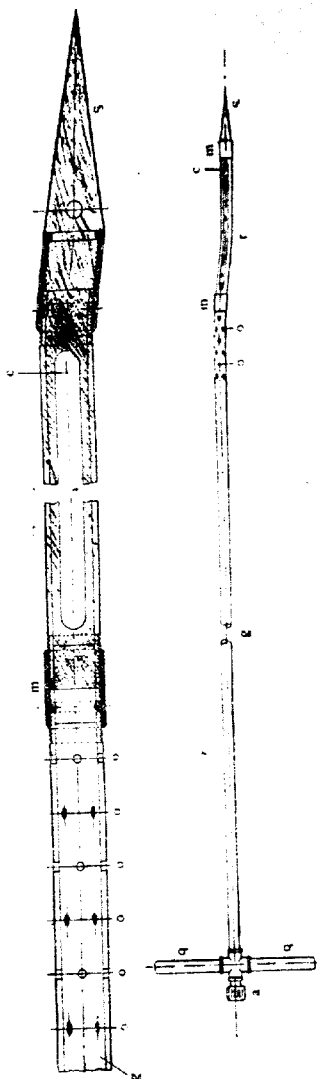
1 - Apparatus to Prevent Spontaneous Combustion of Hay Ricks. — FORDI, ERNST, in *Deutsche Landwirtschaftliche Presse*, Year 44, No. 49, p. 388. Berlin, June 29, 1917.

The solid appliances at present in use for preventing the spontaneous combustion of stacks of hay, or of other forage, do not permit of the introduction into the stack of extinguishers at the points where the temperature might be nearing the danger point.

After having established the points where the temperature was rising in the stacks used to be soaked with water, which rendered the forage practically useless. The writer describes an apparatus, of which an illustration is appended, which remedies the above drawbacks and enables the temperature in the stack to be controlled by means of a thermometer and the use of extinguishing liquids in case of spontaneous combustion.

The apparatus consists of a tube for the escape of gases *g*, with a thread on the outside for screwing on a flexible tube and below, on the inner end of this thread, two transverse arms *q* about 40 cms long; at the other end is screwed on a point *s* about 18 cms. long. The whole apparatus is about 3 metres in length; the tube *g* is of 3/4 inch gas piping. Acting as a continuation of the point *s* is a removeable piece *r*, about 34 cms. long, of which the hollow can be fitted with a maximum thermometer. The portion *r* can be removed and the point *s* (perforated transversely in order to allow of screwing or unscrewing without difficulty) fixed directly on to the tube *g*. The part *s* and the part *r* with the thermometer are both provided with sleeves *m*, screwed and riveted and furnished with an inner thread by means of which the parts *g*, *r* and *s* can be fitted to one another.

The extremity of the part *g*, connected with the pieces *r* and *s*, is, per-



Apparatus to Prevent Spontaneous Combustion of Hay Ricks.

forated for 15 cms. of its length with 24 small openings 0.4 mm. in diameter, arranged regularly about the circumference of the tube g.

The apparatus possesses the following advantages.

1) It enables the temperature in the stack to be read.

2) It allows of the use, when the temperature reaches a dangerous height, of any method of extinguishing known, in order to prevent spontaneous combustion. There is consequently less amount of spoiled fodder and the method is simple in every way.

3) By using several of these devices sufficient ventilation can be obtained to carry off the dangerous gases which develop inside the stack.

4) With the solid devices employed at present, taking the temperature is an exceedingly dangerous operation, for, at the movement of their withdrawal, the gases are capable of igniting. The apparatus described above allows of the introduction into the stack of extinguishers and so prevents fires.

For working inside barns a collapsible apparatus has been devised consisting of 2 pieces each 1.50 m long: after the first piece has been dug into the stack the second is screwed into it and the apparatus then pushed home.

When fermentation has already begun, several instruments are used of big calibre in order to obtain sufficient ventilation. In order to control the temperature, a sensitive thermometer is used which can be introduced and withdrawn by means of a shaft.

The FORDI apparatus is patented in Switzerland under No 741

- **Making Milk Bottles of Paper.** — I. *Scientific American*, Vol. XCVI, No. 11, p. 175, 3 figs. New York, March 17, 1917. — II. *Les Inventions Illustrées*, No. 6, pp. 8-9. Paris, June, 1917.

Doctors and health experts in the United States condemn the glass milk bottle as a pernicious germ-carrier. They are demanding that tractible bottles be used for the distribution of milk for the home, so that they cannot be returned to the dairy to be refilled and sent out another one laden, perhaps, with germs picked up during previous use. Pennsylvania was the first state to proscribe the use of the glass bottle as being continual menace to the public health.

Some dairies of the progressive type had already begun to employ tractible bottles made of light cardboard coated with paraffin. Milk can be kept in a fresh condition in these paper bottles many hours longer than in the glass bottles, being both air and light tight.

A machine has been invented capable of manufacturing paper milk bottles at the rate of 5000 an hour. It is 90 feet long and costs over 1000 dollars. Wood pulp is the raw material employed. The process does not require exclusively high-priced paper pulp; any fibrous wood is fit to work equally well. One ton of pulp will produce 60 000 bottles, owing to the low cost of manufacture the new paper bottle is said to be cheaper in the long run than the common glass bottles in use at present time. Only 3 men are required to work the machine, and from beginning to end the milk bottle is handled only by steel fingers, so that the apparatus meets all sanitary requirements.

The process of manufacture is simple. A steel core is dipped into a vat of raw pulp and, by means of 4 clamps, the pulp is pressed round the core into a seamless bottle. During this operation the bottle revolves several times, the clamps pressing at every third of a turn.

The bottle next passes through a powerful drier and over a stencil which prints on it the name of the milk dealer, the capacity of the bottle, etc. It is then removed from the core by a steel hand and deposited on a belt conveyor which crimps on the bottom and the top. The bottle is then given a paraffin bath that renders it impervious to liquid or acid and is automatically packed in dust-proof cartons for delivery to the dealer.

The operation is continuous and it takes about 8 minutes to convert raw pulp into the completed bottle.

- Review of Patents.

Tillage Machines and Implements.

Canada	175 993. Plough mechanism.
United Kingdom	106 162. Turf-cutting machine. 106 315. Cultivating implement. 106 551. Spades, forks, for disabled men.
United States	1 227 745 — 1 229 354 — 1 231 225 — 1 231 237 Ploughs. 1 227 938 — 1 228 273. Agricultural implements. 1 228 134. Tractor plough and cultivator. 1 228 695. Disk mounting for plough. 1 229 170. Cultivator.

- 1 229 157. Three wheeled cultivator.
- 1 229 488. Coil spring seat for disks.
- 1 229 868. Earthworking implement.
- 1 229 970 — 1 230 243. Cultivator attachments.
- 1 230 022. Sweep stock attachment.
- 1 230 084. Plough-guide.
- 1 230 194. Harrow.
- 1 230 261. Tilling machine.
- 1 230 339. Power plough.
- 1 230 716. Disk harrow cleaner.
- 1 231 352. Power driven cultivator.
- 1 231 398. Harrow.
- 1 231 502. Cotton chopper.

Fertilisers and Manure Distributors.

- United States 1 227 701 — 1 230 069 — 1 231 199. Fertiliser distributors.

Drills and Seeding Machines, etc.

- Switzerland 75 523. Seeder attachment.
- United States 1 228 682. Gage wheel attachment for planters.
- 1 229 158 — 1 231 398. Planters.
- 1 229 604 — 1 229 988. Maize planters.
- 1 229 941. Check row planter.
- 1 230 350. Peanut planter.
- 1 230 465. Potato planter.
- 1 230 806. Plant setting machine.

Various Cultural Operations.

- Canada 176 094. Hoe for weeding.
- Switzerland 75 412. Electrocultural process and installation used also for destroying parasites and locusts.
- United States 1 228 935. Weeder.
- 1 228 992. Hocking machine.
- 1 229 355. Lister cultivator.

Reapers, Mowers and Harvesting Machines.

- Canada 175 694. Harvester, thresher, etc.
- United Kingdom 105 983. Gathering fruit.
- 106 105. Sweeping lawns, etc.
- United States 1 228 238. — 1 229 598. Cotton picking machine.
- 1 228 403. Mower knife sharpener.
- 1 228 971. Maize husker, ensilage cutter and silo filler.
- 1 229 000. Mowing machine.
- 1 230 127. Hay mowing apparatus.
- 1 230 822. Pea harvesting machine.
- 1 230 863. Horse hay-rake.
- 1 231 174. Sickle bar.
- 1 231 195. Shocking machine.

Machine for Lifting Root Crops.

- Canada 175 841. Potato digger.
- United Kingdom 106 341. Potato diggers and harvesters.

- ited States 1 228 562. Peanut digger.
1 229 372. Potato digger and pulveriser.

Threshing machines.

- ited States 1 229 063. Thresher or separator.

Machines and Implements for the Preparation and Storage of Grain, Fodder, etc.

- ada 175 774. Grain tank.
175 835. Shock gatherer.
176 536. Bag jolter.
176 542. Tire securing device.
tizerland 75 408. Green fodder press.
75 409. Device for preventing spontaneous burning of hay stacks.
75 410. Green maize silo and press.
ited Kingdom 106 014. Hand propelled vehicles for goods.
106 565. Hay elevators.
ited States 1 227 761 — 1 231 354. Hay press.
1 229 031. Hay stackers.
1 229 036. Hay handling device.
1 229 126. Baling press.
1 229 640. Hay loader.
1 230 066. Hay rake or stacker.

Forestry.

- ited Kingdom 106 557. Sawing.

Traction and Steering of Agricultural Machinery.

- ada 176 339. Motor tractor.
176 458. Hitch.
ted Kingdom 106 648. Traction engines.
ted States 1 227 576. Universal tractor.
1 227 630 — 1 230 014 — 1 230 340 — 1 230 430 — 1 230 655 — 1 231 408.
Tractors.
1 228 024 — 1 228 895 — 1 229 210. Tractor wheels.
1 228 306. Motor tractor.
1 228 377. Automatic steering-gear for tractors and the like.
1 228 688. Caterpillar tractor.
1 228 709 — 1 229 462. Traction engines.
1 229 865. Control mechanism for tractors and the like.
1 230 294. Draft evener for harrows.
1 230 539. Steering mechanism for tillage implements.
1 230 648. Operating mechanism for tractors.

Housing of Livestock.

- ted Kingdom 106 007. Disinfectant.
106 012. Destroying insects.
106 644. Making horseshoes.
ted States 1 229 094 — 1 229 435. Hog olters.

Ariculture.

- ted Kingdom 106 117. Temperature alarms.
106 218. Crates for eggs, etc.
106 405. Boxes for eggs.

Industries Depending on Plant Products.

- Brazil 9 988. New heating and cooling apparatus for rapid heating of alcoholised wines and means of handling.
- Canada 175 940. Apple slicer.
176 317. Method for decorticating flax.
- United Kingdom 106 479. Vinegar vat.
106 513. Yeast for bread making.
106 642. Distilling and evaporating liquids.

Dairying.

- Canada 175 463. Rennet.
175 633. Sterilizing apparatus.
175 712. Milk preparation.
176 311. Teat cup.
- Switzerland 75 444. Butter-tub.
- United Kingdom 106 048. Storing bottles, cans, etc.
106 200. Boxes.

Farm Buildings.

- Canada 175 682. Gate.
176 081. Window holder and lock.
176 591. Grain elevator.
176 644. Wire stretcher.
- Switzerland 75 411. Hothouse.
- United Kingdom 106 368. Fence post.
- United States 1 227 928. Silo construction.

Various.

- Canada 175 777. Harness.
176 226. Oil can.
- United Kingdom 106 512 — 106 514. Filters.
106 564. Cooking and like apparatus.

845 — **Equipment for Farm Sheep Raising.** — MACWHORTER, V. O., in *United States Dep. of Agriculture Farmers' Bulletin* No. 810, 27 pp., 37 figs. Washington, D. C., June 1917.

The object of this publication is to furnish a practical guide for equipping farms for sheep raising. Owing to the wide differences in climatic conditions it is not possible to suggest a particular type of building for all parts of the United States.

The above bulletin contains numerous plans of buildings, some showing combinations to contain horses, cattle, sheep, etc., others intended for sheep only; at the same time scope is left for private initiative to choose the building which is best suited to the particular conditions of the farm in question. Equipment for raising sheep is not expensive. In mild latitudes little housing is required, and the main need is for fencing and pastures of sufficient number and size to allow frequent changing of flocks to fresh ground to insure health. For enclosing sheep pastures and lots a fence that will exclude dogs should be used. The dog-proof fence should be 37 inches high, the posts 7 1/2 feet long, set 2 1/2 feet in the ground. Close to the ground should be set a tightly stretched barb wire, next to which is a 36 inch woven-wire fence with 4-inch mesh and above this 3 strands of barbed wire. Portable hurdles are illustrated and described.

When winters are longer and more severe, buildings and sheds are necessary to furnish protection from storms, though no special provisions are needed for warmth. Dryness, good ventilation and freedom from draughts are the first requisites of buildings for sheep.

Convenience in feeding and shepherding must also be held in mind in planning and planning such buildings or sheds. Abundance of light is necessary for the health of the sheep.

One square foot of window for each 20 square feet of floor space is necessary. Small flocks can be cared for in sections of barns having stabling and feed storage for other stock, but with a flock, of say, 100 ewes, separate buildings are desirable. The interior arrangements of these buildings should be such as to require a minimum of labour and the least possible moving of the ewes in doing the feeding and caring for them during the lambing season. Ample yard space that is dry and sheltered should be available adjacent to the main barn or shed.

Level and well drained clay-surfaced floors are satisfactory and economical. Concrete floors for alleys and feed rooms are necessary, but it will seldom be called for in the pens.

Instructions are given for the construction of feed racks, wooden grain troughs, etc.; some fixed and others with moveable parts or completely portable and the same with automatic feeding arrangements. The descriptions are accompanied by very clear drawings giving all necessary dimensions.

A list is appended to the bulletin containing references to all the publications of the U. S. Dept. of Agriculture relating to sheep raising.

RURAL ECONOMICS.

The Utilisation of the Profits made by Swiss Peasants. — LAUB, ERNST, in *Archiv für soziale Wirtschaftsforschung*, Vol. 8, Pt. 3, pp. 367-385. Jena, 1917.

Efforts to improve the condition of agriculture by increasing the price of products are frequently met with the reproach that any increase of income which may result will only have the effect of raising the price of property, so that an increase in the price of products will do more harm than good to the farmer and his descendants. If this be really so, the effect would be noticeable first of all in the use to which the farmer puts his profits.

Taking agricultural accounts as his basis, the author has examined the replacing of the profits of the Swiss peasant. This investigation was made during the war, a fact which must be borne in mind when considering the results; it is to be continued. The accounts of 241 Swiss farms were used; these had been submitted in 1915-16 (from March 1 to February 29) to the control of the Swiss Peasant's Society.

Table I gives the most important results of the final accounts, calculated since 1901; they are classified according to the size of the farm and give information as to the profits realised.

The 3267 accounts examined showed an average profit of £188 per

TABLE I. — Profits realised on Swiss farms.

TABLE A.—*Four Types of Farming in the United Kingdom, 1901-15*

Year	Number of ledger	Total income	Income of estate and household	Expenditure	Change in income	
					Total	After deduction of income from dependent branches
1) Small farms (7 to 12 acres)						
		£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
1901-05	76	98 15 11 1/2	79 9 6	83 12 8	+ 15 6 5	—
1906-13	236	112 7 0	81 14 10 1/2	88 9 3	+ 23 17 0	+ 6 15 5
1914-15	48	116 7 9 1/2	94 12 11	91 9 8	+ 24 19 2	+ 3 4 2 1/2
1901-15	360	108 7 4 1/2	82 13 7 1/2	87 5 0	+ 21 2 5	+ 4 11 5
2) Small peasant farms (12 to 25 acres)						
1901-05	232	140 4 7 1/2	112 6 2	107 11 2	+ 32 19 10	+ 4 14 11
1906-13	889	157 19 9	130 11 8	115 2 6	+ 42 17 3	+ 15 15 6 1/2
1914-15	223	175 0 11 1/2	154 11 6 1/2	122 5 11 1/2	+ 52 14 11 1/2	+ 31 11 6
1901-15	1344	154 7 8 1/2	127 9 9 1/2	113 2 0 1/2	+ 40 15 9	+ 14 1 2
3) Peasant farms (25 to 37 acres)						
1901-05	175	178 1 0	155 10 3 1/2	130 18 6 1/2	+ 48 2 5	+ 20 11 6
1906-13	478	213 3 8 1/2	171 10 3 1/2	141 5 2 1/2	+ 62 3 10	+ 30 11 5
1914-15	124	249 0 9	222 4 5 1/2	154 5 6	+ 86 0 8	+ 68 4 1
1901-15	777	200 19 10	171 4 4	139 4 6	+ 62 1 8	+ 22 6 2
4) Large peasant farms (37 to 74 acres)						
1901-05	148	224 14 0	185 0 9 1/2	167 18 3 1/2	+ 56 15 5 1/2	+ 17 2 5
1906-13	364	266 0 11	223 0 5	163 1 11 1/2	+ 102 18 11 1/2	+ 60 5 5
1914-15	96	292 16 9	267 1 2 1/2	164 17 4	+ 127 19 5 1/2	+ 102 11 1/2
1901-15	608	255 15 6	216 4 5	164 18 9	+ 90 16 8	+ 51 5 5
5) Large farms (74 to 173 acres)						
1901-05	31	269 4 1 1/2	244 13 2	157 12 4 1/2	+ 112 5 7	+ 87 7 1/2
1906-13	114	326 6 1 1/2	293 19 6	206 5 11 1/2	+ 117 15 8	+ 87 11 6
1914-15	33	398 12 10	385 2 7 1/2	232 6 6	+ 166 12 7 1/2	+ 153 2 1/2
1901-15	178	315 10 8 1/2	289 13 4	183 12 10 1/2	+ 121 18 1	+ 96 7 1
6) Averages						
1901-05	662	170 16 10	141 18 1	126 11 10 1/2	+ 44 5 0	+ 15 6 1/2
1906-13	2081	190 18 1 1/2	159 5 5 1/2	131 7 7	+ 59 10 6	+ 28 4 2
1914-15	524	224 8 0 1/2	199 18 6	141 16 11 1/2	+ 81 11 2	+ 58 8 1
1901-15	3267	180 11 9	158 16 9 1/2	131 5 4	+ 57 8 3	+ 27 10 7

farm; £30 represent the income from dependent enterprises. The expenditure did not quite amount to £131.10.0, so that about £56.10.0 (30% of the income) were saved. The years 1901 and 1913 were the worst, the years 1912 and 1915 the best. As for the two years of war, 1914 and 1915, the first was slightly below the average. On an average, during the two years

war, the Swiss peasants did not even make £29 more than the average in 1911 to 1915. If it be considered that these figures do not include the lease of fertilising elements in the soil, and that 1915 was a very good year, it cannot be said that the Swiss peasants have made large war profits. The investigations into the use of the profits, made only for 1915-16, did not include all the farms, as the author no longer had the books of some farms and on others exceptional conditions (inheritances, etc.) made comparison difficult. For this reason the average figures do not coincide exactly with those of Table I.

The peasant's profits are derived either from the farm or dependent enterprises; he uses them, partly for new acquisitions on his farm, partly for the dependent enterprises, and partly for household goods. The figures even do not show the objects bought, but only the change in stock. Amortizations, the year's losses and sales are placed apart from the new acquisitions.

Table II shows the total change in the net income (minus debts still to be received) in the four accounts, estate, household, dependent enterprises and expenditure.

TABLE II. — *Total change in net income (averages of all the farms).*

Number of farms	Change in net income in 1915-1916				
	Estate	Household	Dependent branches	Private expenditure	Total income
	<i>Amount per farm.</i>				
241	£ 76.13.10	£ 2.10.1	£ 32.9.7 1/2	£ 0.11.6	£ 112.5.0 1/2
	<i>Percentage of income.</i>				
241	68.68 %	2.20 %	28.62 %	0.50 %	100

About 2/3 of the profits were either re-invested in the estate, or used to pay off the outstanding debts on the estate. A little less than 2/10 were put into the dependent branches, and the rest went to the household (kitchen) and private expenditure.

Table III shows the different uses to which the income was put in percentage of the estate.

It is characteristic that a minimum part (not even 1/10) of the profits was invested in *land*. The money invested in *improvements* rose by about 20% that invested in *buildings* was even reduced, probably by regular amortizations or lack of buildings. A slight increase is noticed for capital invested in *fruit-trees*. The decrease in capital invested in *vines* proves that, during the war, and in spite of the relatively good wine harvest of 1915, Swiss farmers continued to pull up the vines. The reduction in the capital invested in *standing trees* may be explained by the absence of imported foreign wood and the large exportation of Swiss wood. The increased capital placed in *crops* is due to the fact that, in 1915-16, the farmers spent rather

TABLE III. — *Distribution of the income in percentage of the estate.*

Capital	Small farms		Small peasant farms		Peasant farms		Large peasant farms		Large farms		Average	
	%		%		%		%		%		%	
Land	35.38		10.93		4.92		8.14		1.74		8.86	
Improvement	1.55		0.77		1.28		0.49		1.27		0.89	
Building	13.45		9.18		6.85		3.28		5.77		0.63	
Fruit trees	0.77		1.43		0.68		0.18		0.08		0.99	
Vines	0.49		0.17		1.03		0.07		—		—	
Standing trees	2.12		0.93		3.62		—		19.77		1.01	
Crops	0.80		0.82		0.31		0.19		0.67		0.63	
Plantations	3.12		3.01		4.28		0.06		18.68		0.21	
<i>Estate capital</i>	20.36		23.89		3.83		5.29		21.44		8.91	
Cattle	37.40		31.63		42.65		51.01		61.83		43.29	
Implements and machinery	3.47		0.87		4.76		0.12		0.59		1.39	
Stock in hand	20.27		4.26		8.43		9.58		5.15		7.57	
Money } Cash in hand	5.08		4.60		14.41		22.27		0.56		11.96	
Money } Debts	4.44		1.28		8.59		5.46		26.94		8.00	
<i>Farm capital</i>	70.66		45.64		78.75		88.20		84.19		71.91	
WORKING CAPITAL	91.02		68.52		62.38		92.49		11.75		89.72	
Mortgages	6.88		22.42		15.96		8.96		35.48		17.74	
Contract debts	2.10		5.05		1.66		2.45		—		1.54	
RESERVE CAPITAL	8.98		30.47		17.62		6.51		22.25		19.16	
TOTAL INCOME OF FARM	116.00		100.00		100.00		100.00		100.00		100.00	

more money on artificial manures than in the first year of the war. (The account only includes the cost of artificial manures for the following harvest).

The total increase in the *estate capital* represents 9 % of the profits invested in the farm. This percentage was probably higher before the war, but these and other figures seem to show that farmers use the smallest part of their profits for increasing their estate capital.

Of all the capitals, that invested in *cattle* (live-stock) has increased most; this is in agreement with the fact that, for some years past, capital invested in cattle has shown an increase on controlled farms; the cattle censuses confirm this result. This seems to prove that the Swiss peasant invests his profits principally in live-stock. It is not the estate capital which has been increased by the profits, but the most important part of the farm capital.

Implements and machinery show a slight increase, but the increase in *cash in hand* is greater; this is partly due to a good harvest year, but chiefly to the higher price of many products. The increase in *debts* may probably be accounted for in the same way. The increase in *cash in hand* arises from better results obtained from the farm, and, above all, from the fact that, during the war, the peasants keep more money by them.

More than $\frac{7}{10}$ of the total profits placed in agriculture come under the heading of *farm capital*, and are 8 times greater than those placed in the *land and estate*.

Of the profits invested in agriculture, $\frac{4}{5}$ are used for new farming implements and $\frac{1}{5}$ only for paying off debts.

The influence of the size of the farm on the utilisation of the profits has then been discussed. In so far as any conclusion may be drawn from the number of farms examined it may be said that: The smaller the farm the greater amount of profits used to buy land. No influence is discernible on the *improvements capital* or the *building-capital*. As far as the *plantations* are concerned, the *standing trees* are only influenced by the size of the farm. The profits invested in *live-stock* also increase with the size of the farm. The figures for *implements and machinery* are not very consistent, but it may be said that small farmers complete their stock with their profits, whereas large farmers buy less. The size of the farm seems to have no influence on the other groups of *farm capital*, or on the *amortization of debts*.

The distribution of the income in percentage of the working and reserve capital of the *household* is as follows (in averages):

Live stock (farm-yard)	6.39 %
Dead stock	13.60 %
Stock in hand (provisions)	63.94 %
<i>Total working capital</i>	83.93 %
<i>Reserve capital</i>	16.07 %
<i>Net household income</i>	100.00 %

The greater part of the increase in income concerns the stock in hand; this is partly the result of variations in price, but it also proves that, during

the war, the peasants show a tendency to assure their provisions by sufficient quantities of stock in hand.

The average change in the income invested in *dependent branches* is as follows :

Investments in non-agricultural enterprises	4.01 %
Bonds, shares, money placed in saving banks.	90.06 %
<i>Total working capital</i>	94.07 %
<i>Reserve capital</i>	5.93 %
<i>Net income of dependent branches</i>	100.00 %

The investment of profits under the form of deeds or in saving bank increases with the size of the farm.

The *expenditure income* cannot be called a capital because it is not used to acquire goods ; nevertheless certain parts of it have today the character of capital. However this may be, it is necessary to consider it when estimating a man's economic position, and the Peasant's Society ask to have it included in the accounts studied. The average percentage of the change in income is :

Working capital	105.15 %
Reserve capital	— 5.15 %
<i>Net expenditure income</i>	100.00 %

The actual figures per farm are exceedingly small. The favourable condition of the market has not caused the peasants to spend large sums on their homes, dress or articles of luxury.

CONCLUSIONS: This study shows how great is the thrift natural to the agricultural population. Although the agricultural income, including wages and interest on capital, reached, during the years 1901-1915, an average of 4/- per day per man, and that the average dependent income did not exceed £29.15.0 per year per family, the Swiss peasant families manage to save an average of £57.3.8 a year. In 1916, the agricultural income rose to 6/- per day's work, the dependent income was only £20.16.0, and yet an average sum of £107.6.4 per farm was saved.

On an average the profits made were used up as follows :

I. ESTATE:		
Land	6.09 %	
Improvements	0.61	
Buildings	— 0.44	
Fruit trees	0.41	
Vines	— 0.22	
Standing trees	— 0.69	
Crops	0.36	
Total: Estate capital		6.12 %
Live stock	29.72 %	
Implements and machinery	0.96	
Provisions	5.21	
Cash in hand	7.94	
Debts	5.49	
Total: Farm capital		49.32 %
Total: Working capital		55.44 %
Mortgages	12.19 %	
Contract debts	1.05	
Total: Reserve capital		13.24 %
Net income of estate		68.68 %
II. HOUSEHOLD:		
Live stock	0.14 %	
Utensils	0.30	
Provisions	1.40	
Total: Working capital		1.84 %
Reserve capital		0.36
Net household income		2.20 %
III. DEPENDENT BRANCHES:		
Investments in non-agricultural enterprises	1.15 %	
Bonds, shares, money placed in saving banks, etc.	25.77	
Total: Working capital		26.92 %
Reserve capital		1.10
Net income of dependant branches		28.02 %
IV. EXPENDITURE:		
Working capital	0.52 %	
Reserve capital	— 0.02	
Net expenditure income		0.50 %
Total net income		100.00

Only 6 % of the total profits were invested in the estate, and about 1 % in the farm. A little more than 13 % went to the amortization of agricultural debts. About 2 % of the profits were used to increase household ; more than $\frac{1}{4}$ were placed in saving-banks, shares, bonds, etc., and $\frac{1}{5}$ were reserved for expenditure.

AGRICULTURAL INDUSTRIES.

847 - Contribution to the Study of the Aldehydes of Wine. — LABORDE, J., in *Annales de l'Institut Pasteur*, Vol. 31, No. 5, pp. 215-252. Paris, May, 1917.

In an introduction the author gives an historical study of the work done on the aldehydes of wine. He points out that the work done during the last twenty years on the presence of acetic aldehyde in fermented liquids, and particularly wine, shows that the formation and disappearance of this aldehyde may be subject to chemical and physical causes. The aldehyde may be formed by the oxidation of ordinary alcohol in contact with the air, and the phenomenon is favoured by catalytic action.

TRILLAT's experiments show that, by virtue of their vital properties alone, the mycoderms of wine form aldehydes. According to KOTVTSCHEN and NEUBERG, the aldehydes resulting from the splitting of the sugar by the yeast represent, during the formation of alcohol, an intermediary product which the hydrogenising influence of the medium changes as it appears. It is, however, possible for small quantities to escape this influence according to the prevailing conditions. This hydrogenising, or reducing, action leads to the supposition that a reductase, secreted by the yeasts, is present.

The aldehydes seem to play an active part in rendering the colouring matter of wine insoluble during ageing; and appear to be the cause of certain bitter tastes, especially that which corresponds to the disease of bitterness.

THE ESTIMATION OF ALDEHYDES IN WINES OR THEIR DEPOSITS. The best method is the colorimetric method with rosanilin bisulphite. It gives an inclusive but satisfactory result, because acetic aldehyde is present in much more considerable quantities than any other aldehyde product which may accompany it.

The method is as follows: 1) the aldehyde is distilled off and concentrated, if necessary in a smaller volume, which is then brought up to a known volume by the addition of pure alcohol, so that the final standard of the alcoholic solution is 50%; 2) the quantity of aldehyde contained in this liquid is determined by the official method.

CATALYTIC PRODUCTION OF ALDEHYDES. — In his work on "*Acetic Aldehyde in Wine*," TRILLAT shows that the proportion of the aldehyde increases according to the nature of the vessel containing the wine and by contact with porous bodies, and that it varies with the temperature, nature of the walls and their degree of porosity, exposure to light and degree of acidity. Sulphurous acid favours the production of aldehydes in white wine.

These different circumstances are partly those under which wine may be stored.

The author has found the chemical phenomenon of the production of alcohol to depend much more on the nature of the wine than was shown by TRILLAT.

When wine is exposed to air it absorbs the oxygen, which combines with its various elements, thus determining the rapid formation of aldehydes. It is sufficient for the wine to absorb oxygen by a few minutes' aeration for the production of aldehydes to continue in the absence of air; if the temperature is raised, it becomes much more rapid.

There is, in wine, some favourable cause, probably of a catalytic nature, which is dependent on the actual constitution of the natural liquid. Wine may contain oxidising diastases but as the production of aldehydes continues after wine has been heated to 80°, a temperature which destroys the diastases, there must certainly be a purely chemical catalytic action.

The formation of aldehyde may be facilitated by 3 principal catalytic agents: 1) tannic matter, more or less combined with potassium; 2) oenoxidase; 3) the oxidase of *Botrytis cinerea*.

1) *Chemical action*. — This seems to be the most important action. In wine, tannic matter (colour and oenotannin in red wine and oenotannin alone in white wine) are always more or less combined with potassium in spite of the organic acids of the wine. This combination acts as a catalytic agent, and its influence is favoured by the particular constitution of the medium, quite independently of the presence of the oxidases.

This fact was confirmed by experiments with alcohol in which gallotannin and potassium had been dissolved in varying proportions.

a) 10 % alcoholic solutions of pure gallotannin were mostly saturated with potassium and exposed to the air. The amount of aldehyde formed at the end of 48 hours was proportional to the amount of tannin in the solution, as is shown by the following table:

Strength of the gallotannin solutions per litre grammes	Aldehyde found per litre grammes
—	—
1.00	0.0065
2.50	0.0250
5.00	0.0250
10.00	0.0470

b) In solutions in which there were 4 grammes of tannin per litre, the amount of potassium was varied (exact saturation was obtained with 1.2 cc. of normal potash per 100 cc. of tannic solution). The following results were obtained:

Volume of KOH added per litre	Oxygen absorbed per litre	Aldehyde formed per litre	Oxygen corresponding to the aldehyde
—	—	—	—
—	125 cc.	Traces	—
6 cc.	325 "	0.030 gr.	7.8 cc.
12 "	325 "	0.065 "	16.7 "
24 "	470 "	0.085 "	22.0 "

2) *Influence of the oenoxidase*. — Oenoxidase, discovered by MARTINAND, is the oxidase of the grape; it is present in wine — as in the grape — in very small quantities.

By heating wine to 85° C. the oxidase is destroyed and the aldehydes are formed less readily than in natural wines; heat has an inhibitory action which is lessened after a certain time, varying with the nature of the wine, and its content in tannic matter (in white wines, which are much poorer than red wines in tannic matter, the difference, in some cases, persists almost indefinitely).

The influence of sulphurous acid when added to natural wine is usually similar to that of heating, but more intense; but equilibrium may be established after fairly prolonged aeration, by combining the two actions the formation of aldehydes may be considerably reduced.

The production of aldehydes in old wines is usually much less important than that in new wines.

3) *Influence of Botrytis cinerea*. — It seems that the oxidase of wines made from grapes attacked by grey mould and other diseases caused by *Botrytis cinerea* may be a very active agent in the formation of aldehydes because of the very energetic oxidation phenomena to which it gives rise and which bring about "casse brune".

In blending wines pasteurisation has the same effect as in normal wines, that is to say, it retards the formation of aldehydes without ever entirely preventing it. In these wines, however, sulphurous acid facilitates the formation of aldehydes by preventing "casse".